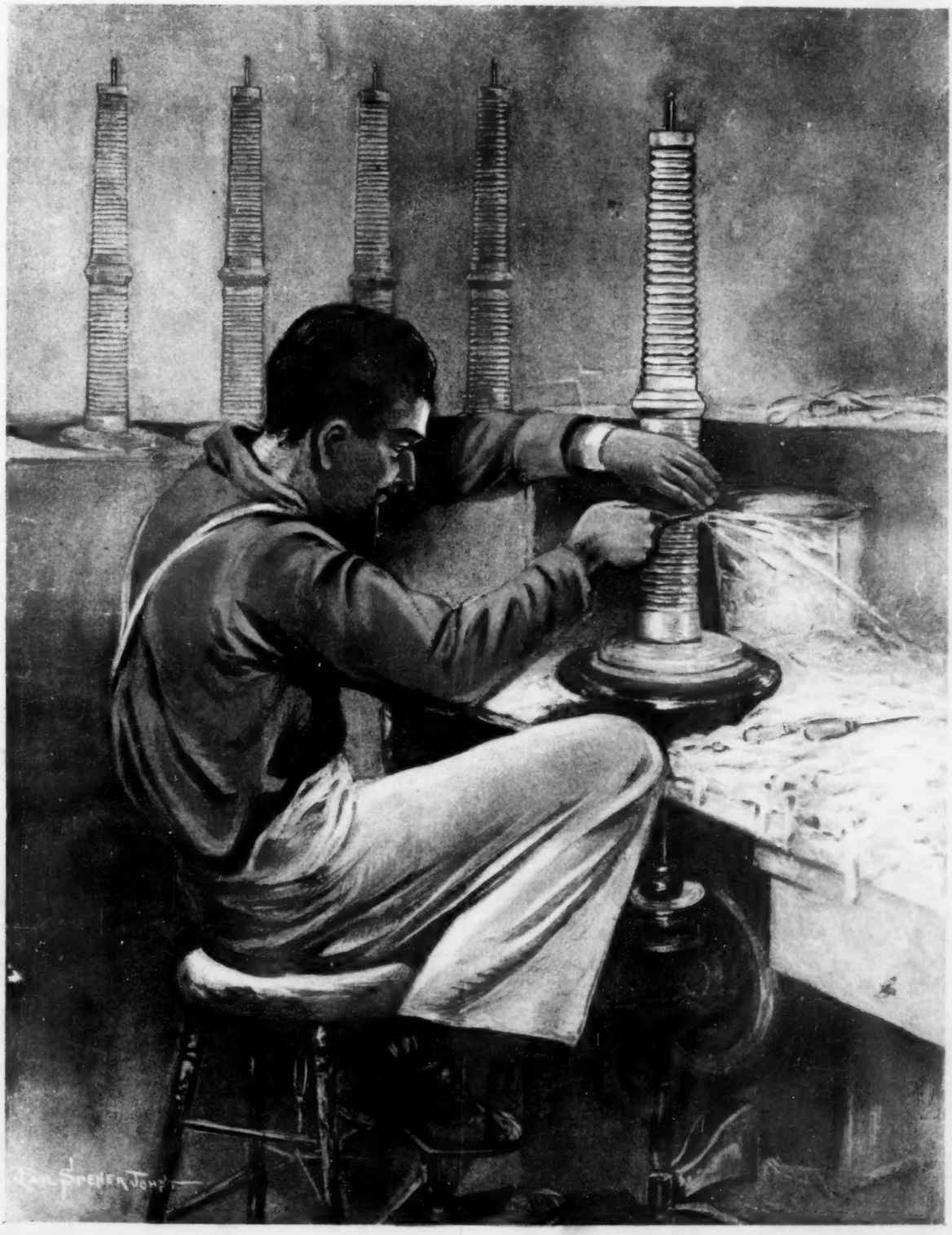
IN THIS ISSUE:

BRIEF FACTS ABOUT MONEY
SOLVING THE LABOR PROBLEM

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



SPINNING AND CUTTING A MASS OF SOFT CLAY TO FORM AN ELECTRIC INSULATOR.—[See page 205]

Vol. CXXIV. No. 11
March 12, 1921

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

Price 15 Cents
20 cents in Canada

SKF
Research Laboratory established at Philadelphia to co-operate with the Gothenburg Laboratories in the study of the American Manufacturers' friction problems.

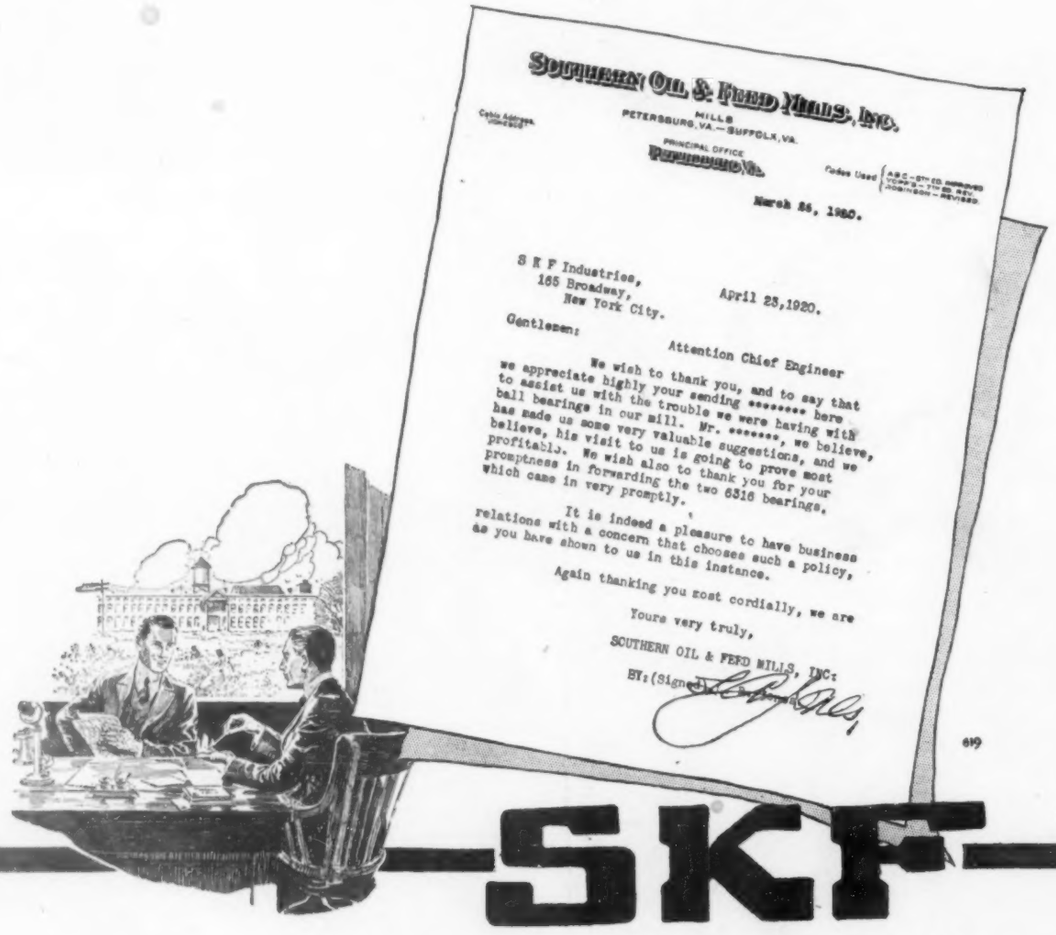
THE technical advice brought you by our engineers embodies the experience of highly trained organizations in all parts of the world in the solving of friction problems.

This international experience is both technical and practical and is acquired in co-effort with the best international research endeavor.

SKF service in America is linked to this international experience. Its tangible evidence is found in products marked "**SKF**" and in the advice supplied you by our engineers.

SKF Industries, Inc.
165 Broadway, New York City

Supervising at the request of the stockholders.
- **The Hess-Bright Manufacturing Co.**
- **SKF Ball Bearing Co.**
- **Atlas Ball Co.**
- **Hubbard Machine Co.**
- **SKF Research Laboratories**


SOUTHERN OIL & FEED MILLS, INC.
MILLS
PETERSBURG, VA. — SUFFOLK, VA.
PRINCIPAL OFFICE
March 26, 1920.
S K F Industries,
165 Broadway,
New York City.
April 23,1920.
Gentlemen:
Attention Chief Engineer
We wish to thank you, and to say that we appreciate highly your sending ******** here to assist us with the trouble we were having with ball bearings in our mill. Mr. ********, we believe, has made us some very valuable suggestions, and we believe, his visit to us is going to prove most profitable. We wish also to thank you for your promptness in forwarding the two 6316 bearings, which came in very promptly.
It is indeed a pleasure to have business relations with a concern that chooses such a policy, as you have shown to us in this instance.
Again thanking you most cordially, we are
Yours very truly,
SOUTHERN OIL & FEED MILLS, INC.
BY:(Signed)
619

SKF

Among these products now offered are:

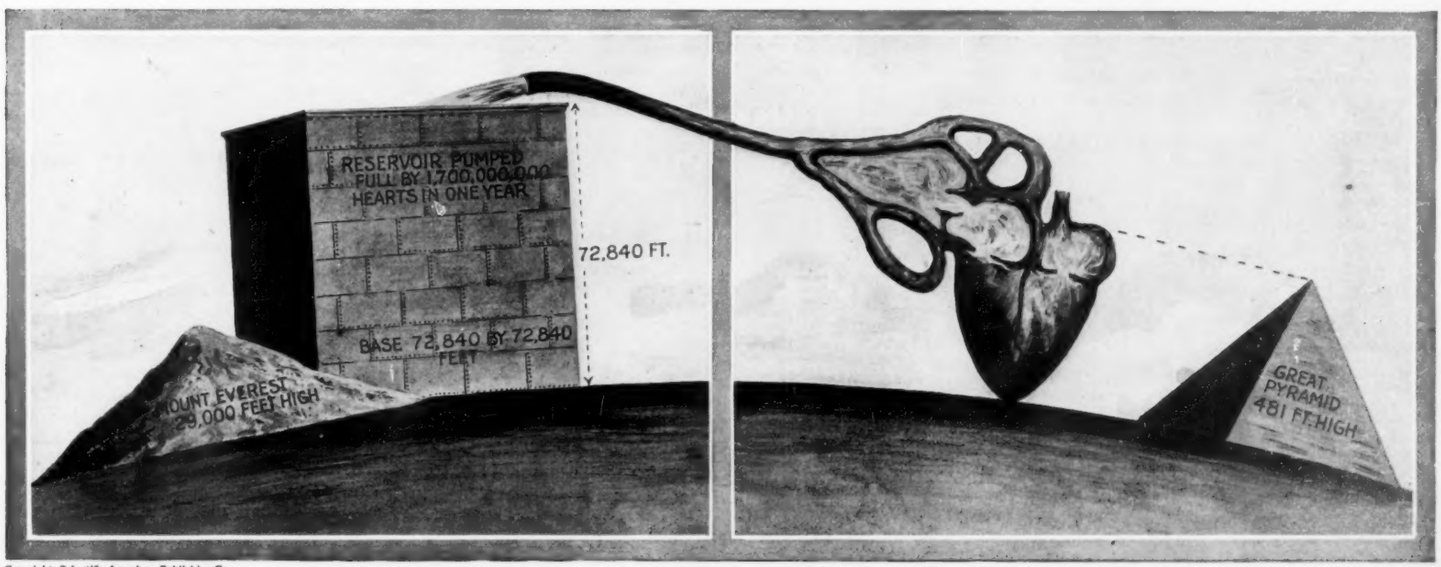
Single row deep groove ball bearings. Thrust bearings. Steel balls.
Double row self-aligning ball bearings. Transmission equipment.

SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIV. NUMBER 11] NEW YORK, MARCH 12, 1921 [15 CENTS A COPY 20 CENTS IN CANADA


RESERVOIR PUMPED FULL BY 1,700,000,000 HEARTS IN ONE YEAR
72,840 FT.
BASE 72,840 BY 72,840 FEET
MOUNT EVEREST 29,000 FEET HIGH
GREAT PYRAMID 481 FT. HIGH

Copyright, Scientific American Publishing Co.

The composite bulk of all the human hearts in the world, and the labor of pumping that they perform

The Heart as a Pumping Engine

By Charles Nevers Holmes

WHAT a wonderful pumping engine is the human heart! From our cradle to our grave, its work is incessant—stupendous. Within each human breast, this energetic organ is beating, on an average, about 75 times per minute, or 4,500 times per hour. Accordingly, the heart beats, approximately, 108,000 times daily, 39,000,000 times yearly, and, during a lifetime of threescore and ten years, two billion seven hundred million times. If we estimate the population of our world at 1,700,000,000 people, then all the human hearts on our terrestrial planet are beating at the rate of, approximately, 127,000,000,000 times per minute, or 66 quadrillion times per year. That is to say, these 1,700,000,000 human hearts are throbbing at a rate of about 2 billion times per second.

As we well know, our heart-engine contains four compartments, two auricles and two ventricles. The auricles are reservoirs, which supply the pumping ventricles with blood. Therefore, the dynamic energy of the human heart resides in the right and the left ventricles. When these ventricles contract, the right ventricle sends its supply of impure blood to be purified by the oxygen in the lungs, and the left ventricle forces its supply of purified blood to circulate in the body. When the "heart beats," that is, when the right and left ventricles beat, an average of about 10 cubic inches of blood is expelled from the heart engine. Accordingly, in a minute, after 75 heart beats the energetic heart has pumped 750 cubic inches of blood. That means the heart pumps 45,000 cubic inches of blood per hour, 1,000,000 cubic inches of blood per day, and 392,000,000 cubic inches or more than 225,000 cubic feet of blood per year. Were the heart a water pump instead of a blood pump, it would expel, inasmuch as a cubic foot of water weighs about 62½ pounds, approximately, 7,000 tons of water, during the course of one year.

And this amount of work is accomplished by only a part of a small muscular organ about as big as the average human fist! It has been estimated that the left ventrical alone exercises sufficient pressure per square inch to support a column of blood 9 feet in height, and that it performs daily an amount of work equal to 90 foot-tons. Were we able to collect in a cubical reservoir all the blood pumped by one heart-engine in one year, that reservoir would be about 61 feet in each of its three dimensions. Or, were it a circular water-tower, with a diameter of 50 feet, it would be somewhat more than 115 feet in height, and it would contain about 1,700,000 gallons. Our drawing depicts the size of a heart representing the combined bulk of all the hearts in the world, and the work performed by the combined hearts in the course of a year.

A Small Submarine Designed for Scientific Research

THE submarine, rightly regarded during the war as the most dreadful monster of the deep, is at last to be tamed and made to serve man instead of destroying him. At a recent meeting of the French Academy of Sciences, in Paris, M. Maxine Laubeux discussed the possibilities of such a baby submarine. He is of the opinion that by its means the various strata of the ocean could be explored directly instead of indirectly, as is now necessary, to a depth of from 80 to 100 meters. According to the figures carefully worked out by him as being most suitable for such a submarine vessel, the length should be 18.80 m., the diameter 2.30 m., and the displacement about 50 tons. The hull is revolving, all the sections being circular. The body is so constructed as to resist safely the pressure corresponding to a depth of from 80 to 100 meters of salt water. Special precautions are taken to keep all openings absolutely water tight even in case of accident. In order to enable it to sit flat upon the bottom of the ocean, the submarine is provided with two keels, while to prevent it from having trouble with currents in tidal waters it is propelled by batteries and an electric motor. The batteries are 43 in number each weighing 188 kg. The motor has an effective power of 50 hp. at 420 r.p.m., with a current of 80 volts.

Under these conditions the maximum velocity of the boat should be about 6 knots on the surface and 4.75 knots when submerged.

Its radius of action at half speed is as follows: Sixty miles on the surface at a speed of 3 knots and 50 miles when submerged at a slow speed of 2.50 knots per hour.

The submarine is to contain the following apparatus besides that required for its own operation: A 30-ton centrifugal pump operated by the principal motor; a 3,000-liter piston pump capable of exerting a pressure of 10 kg. with the electric motor; a periscope; two windlasses—one for the grappling iron and one for the rear weight; two reservoirs of compressed air (from 150 liters to 120 kg.); an electric fan for use during the recharging of the battery; a compass; a telephone; a grappling iron of 80 kg. weight and 160 meters of steel cable; an 80 kg. lead weight for plumbing with 160 meters of steel wire cable.

The estimated price of such a scientifically equipped submarine is 600,000 francs or possibly more, whereas when the project was first considered in 1907, it was estimated that the cost would be less than 200,000 francs.

It is between the surface and a depth of from 80 to 100 meters that most of the great schools of fish which serve mankind as food move and have their being, and it is for this reason that the information gained by such a boat is expected to be so important. Its various functions would include taking samples of the surface layer of the bottom of the ocean at different depths, taking samples of the water in various locations and at different depths in order to make a study of the density, temperature, percentage of salt, etc., and obtaining samples of the plankton upon which so many fish depend for food. Obviously the distribution of plankton and the circumstances favorable to its growth are all-important with regard to the abundance of the fish which feed upon it. Other valuable information would also be gained by studying the degree of transparence of the water and the intensity of the light at different depths. Finally, the direction and velocity of the currents at various depths would be especially investigated and would undoubtedly prove valuable in various ways not only to the meteorologist but to the captains of ships and to fishermen.

THE SCIENTIFIC AMERICAN, March 12, 1921. Volume 124. Number 11. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price, $6.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.
Founded 1845
New York, Saturday, March 12, 1921
Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class matter. Trade Mark Registered in the United States Patent Office.

Copyright 1921 by Scientific American Publishing Co. Great Britain rights reserved. Illustrated articles must not be reproduced without permission.

"A Strong Navy"

WE are in receipt of a letter from an ex-officer of the United States Naval Reserve force who is puzzled by the present attitude of the SCIENTIFIC AMERICAN toward the United States Navy. "I noted with gratification in the old days," he writes, "that you were ever the champion of a strong navy. What has happened? Has the controlling ownership changed? Are you the same journal which ten years ago cried out for a strong navy?"

Possibly the same question has arisen in the minds of other readers; so we take this opportunity to state that nothing has happened; that the controlling ownership has not changed, and that we are the same journal which ten years ago—twenty-five years ago for that matter—and down through the years without a break, has been consistently the friend of the Navy and has done its best to encourage Congress and the people to build up a strong navy.

It is not we who have changed, but the General Board of the Navy and the Senate Naval Committee, who, since the armistice have adopted an entirely new policy; for at the close of the war, they demanded the strongest navy in the world and today they ask for a navy as strong as any other.

To understand the significance of this we must remember that the pre-war policy of the General Board was to carry on a continuous program of construction, which would give us by 1921-1922 a total of 48 battleships including our earlier ships. This policy would have put our navy in the second place, which we had held in 1904, but, due to Congressional neglect, had since lost to Germany. By the wiping out of the German fleet we moved up to the second position. The General Board then raised its standard by demanding that we build a navy stronger than any other.

The British have insisted that because of their insular security they should possess a navy stronger than that of any other. Recently they have stated semi-officially that they would view without alarm the construction by this country of a navy of whatever strength it saw fit, since the policies of the two countries are so similar that a resort to armed force in place of arbitration of any disputed question was inconceivable. If the people of the United States are prepared to bear the expense, the SCIENTIFIC AMERICAN can see no reason why we should not possess a navy equal to any other. This, of course, involves the construction of a strong navy; and, as we have shown in a recent issue, the completion of the 1916 program (less the six battleships of 43,000 tons), and the addition of some vessels of the smaller types in which we are lacking, will make our navy equal in strength to any other.

If for the present we hold up construction on these six ships, it will mean a saving of some 240 million dollars. If we go ahead and build them now it will mean that we are greatly exceeding the standard of equal strength above referred to. The General Board has suggested that we do not build certain destroyers and other smaller vessels, already authorized, which would have cost about 60 million dollars, and that we utilize 50 millions of that money in the construction of two airplane carriers. This is a good suggestion. The balance of the 60 millions, together with some 40 millions of the 240 million dollars saved on the six battleships, could be utilized in the construction of flotilla leaders and a few additional scouts. Such a program would mean a net saving of at least 200 million dollars and its completion would, in our judgment, give us a fleet which, because it was so thoroughly up-to-date and included all the lessons of the late war, would be more than a match for anything afloat upon the seas by 1923-1924.

Let it be remembered also that age is a great determining factor in estimating the relative efficiency of fleets. If Great Britain persists in her determination to lay down no new construction, it will mean that by the time our new navy is completed her finest battleships will be from eight to nine years old; whereas our latest ships will be only from one to five years old. The British ships will mount as their heaviest piece a 15-inch gun of about 84,000 foot-tons muzzle energy, whereas our best ships will mount among them 16-inch guns of 99,000 or 112,000 foot-tons energy, according as they are 45 or 50 calibers in length. The British battleships will be of 28,000 tons as against our 32,600 tons, and the armor and torpedo defense of our ships will be far more extensive and heavy. Lastly, it must be remembered, reverting again to the question of age, that a battleship ten years old is considered to be obsolescent and ready to pass into the second line.

We have made it clear, we trust, that the SCIENTIFIC AMERICAN, in spite of its opposition to the *immediate* building of these six ships, is, today as always, an earnest advocate of our possessing "a strong navy." We think we have made it clear, also, that if Congress decides to spend 240 million on these unnecessary ships, it will be going far beyond the standard of strength which the Navy Department has itself laid down.

Einstein's Finite Universe

THE daily papers have once more featured Dr. Einstein on their front pages, this time on the basis of an interview in which he expressed his conclusions with regard to the figure and extent of the universe. To those who are at all familiar with the General Theory of Relativity, the fact is not new that it leads to the conclusion that the universe may be finite though unbounded. To those lacking this familiarity the statement may be more or less surprising; and to the average layman, not alone do the two terms "finite" and "boundless" carry a distinct contradiction, but the whole discussion comes altogether as a mental upheaval.

As a matter of fact, to the qualified geometer and even to the philosopher who is not inclined to geometrize it is anything but that. From the earliest age it has been recognized that the universe presents to the human mind a dilemma which in either event transcends our ability to form a concrete picture. It is obvious that we must regard the universe as extending infinitely, forever, in every direction; or that we must regard it as not so extending. Both possibilities go beyond us. The mathematician will make a more or less whole-hearted claim that an infinite universe does not go beyond him; but all he means is that he can abstract some of the properties of such a universe and represent them symbolically. He can never really picture infinity. And certainly, on the other side, the suggestion that the universe comes to an end brings an unanswerable puzzle in the immediate query: what lies beyond?

Modern philosophy has suggested a way out of the dilemma. For a century or more the notion of a geometrical continuum which shall have no limits and which yet shall not be of infinite extent has been mentally chewed over by philosophically inclined mathematicians and mathematically inclined philosophers. The spherical surface is an example of such a continuum in two dimensions. It returns upon itself completely; and *so long as we confine ourselves to the two dimensions in which it is defined*, there is nothing beyond it. It is finite, yet unbounded; there is no jumping off place. To be sure, there is a three-dimensional universe about it, outside it, in which it is immersed, and through which it curves about to meet itself; but that is beside the point.

Those skilled in the juggling of the mathematical symbols of hyper-dimensionality have for many years recognized the possibility that the three-dimensional world of our concepts and perceptions may behave in somewhat the same fashion, and be in fact without end and at the same time without limitless expanse. But the suggestion has heretofore been purely one of abstract geometric speculation. No measurements have ever been made which gave the slightest groundwork of observed fact on which to base the belief that the universe was non-Euclidean—which of course it must be if it be finite and boundless. Even Einstein has not been able to make such measurements; but he *has* suggested a comparatively simple observation which we may confidently hope some day to make, and which would indicate whether the universe is truly infinite or not. This business of observing the distribution of matter throughout the universe, ambitious as it sounds, is really a more hopeful thing than the attempted measurement of geodesics in the expectation that they may reveal non-Euclidean characteristics.

It is doubtful whether any of the eminent geometers who have speculated as to the possibility of a finite universe, or even believed in it, would have dared set the size at any such figure as Einstein suggests. Ten trillion times the astronomical unit defined by the distance from sun to earth is by all means a tremendous figure; and it does not lose much of its awe-inspiring character when we reduce it to light-years and find that, subject to the large margin of error necessarily inherent in such calculations as these, it would take light a billion years to return to its starting point after "circumnavigating" the universe. As one of the newspaper headlines suggests, this is sufficiently near to an infinite universe for all practical purposes.

The Distribution of the World's Four Greatest Liners

IF we except the "Leviathan," it can now be stated definitely what is to become of the four greatest liners, all 900 feet in length or over, about which, ever since the armistice, there has been more or less ambiguity. So frequently has it been stated that ships of this size are not revenue earners, that it would not have very greatly startled the public to learn that these ships were to be laid up, and that future passenger service would be carried in those always popular freight-and-passenger vessels which, although their speed is not nearly so great, possess every comfort and convenience that can be found in the 23-knot ship of 50,000 tons and over.

The first 900-foot ship to be built was the "Imperator," which was constructed by the Vulcan Works at Hamburg for the transatlantic service of the Hamburg-American Company. This fine vessel was not a complete success, being considerably over-weight and over-draft at the time of her launching. She is turbine-driven and has made between 22 and 23 knots when in her best condition. After the armistice she was allocated to the British Government as part compensation for submarine losses, and she has recently been purchased by the Cunard Line for their New York-Southampton service. If she were changed from coal to oil-burning and certain unnecessary deadweight were removed from the ship, she should have no difficulty in making her contract speed, if the company so desired.

The Hamburg-American Company also laid down two ships of the "Imperator" type but somewhat larger and faster. They were built by Blohm and Voss at Hamburg, and the first of them to go into service was the "Vaterland," which made two or three trips to New York in 1914, and was interned here during the war. She is a 23-knot boat and is some 40 to 50 feet longer and two feet wider than the "Imperator." After serving as a transport for American troops she was turned over to the United States Shipping Board, and now for over a year has lain at her Hoboken dock with a caretaking crew aboard. The future of this ship is problematical.

The sister ship to the "Leviathan," the "Bismarck," was partially constructed at the outbreak of the war, and work was done upon her during the war in a desultory way. She is now completed all but some of her interior furnishings, and she has recently been purchased by the White Star Line, who have renamed her the "Majestic." She also will be placed in the New York-Southampton service.

The fourth in size but fastest of the 900-foot liners is the "Aquitania," of the Cunard Line. She is a 900-foot ship, but is somewhat smaller in displacement than the "Imperator." She entered the New York-Liverpool service of the company shortly before the outbreak of the war, and was taken over by the government for transport service. Recently she has undergone overhauling and reconstruction, and under her new oil-burning system this fine vessel has shown that she can exceed her contract speed.

Electricity

Argentine Radio.—From Buenos Aires comes the report that the German Telefunken organization is to construct a high power wireless station in Argentine Republic for the Transradio Compañia Radiotelegrafica Argentina. This company has been organized to operate over-sea wireless telegraphy between Argentina and Europe. Material for the six 210 meter towers, as also the high-tension machinery, was to be shipped shortly; the wireless apparatus itself is not expected until after the erection of the towers.

Germany's Experience with Iron Conductors does not seem to have been a happy one. Wires were used for conductors up to 6 mm. in diameter, and cables for conductors of larger size. One source of trouble was the inevitable kinking of the line. The galvanizing was easily damaged, and in making joints and erecting the lines extreme care was found necessary. Moreover, iron proved to be 20 per cent more expensive than copper, though the price per kilogram was only 0.71 mark as against 4 marks for copper. The use of copper is being resumed as quickly as possible.

Electric Hardening of Tools has come into extensive use in Germany, and seems to be quite practical. In the process of electrolysis the hydrogen generated at the cathode is heated to such an extent that the cathode itself is brought to a red heat. Advantage is taken of this phenomenon by using tools that are to be hardened as the cathode. It is, however, necessary to protect the cutting edges of the tools, as they are liable to be raised to excessive temperatures. The cutting edges are covered with a layer of non-fusible conducting material.

The Nauen Radio Station represents quite nicely the rapid development of wireless. Thus it was first installed in 1906 as a modest 10 kilowatt experimental plant, later it was increased to 35 kilowatts, then to 100 kilowatts, and now to two high-frequency generators of 150 and 400 kilowatts, respectively. The 100-kilowatt transmitter, a spark set, is still in use, being employed in conjunction with the 150-kilowatt high-frequency alternator set for the time signal and meteorological, as well as the transcontinental, services. The 400-kilowatt set is serving as the transmitter for the overseas traffic.

Radio Messages to Your Office.—By the use of the telephone lines radio messages from stations overseas can now be automatically relayed to your office in any part of this country without going through the hands of the operators at the wireless receiving station, according to the traffic... the Radio Corporation of America. In a short time An operator will be able to tap a telegraph key at Seattle and his message will be relayed to the wireless station at New Brunswick, N. J., and thence flashed across the Atlantic to Europe. An amplifier is used at the receiving end to make the sounds as clear as possible. Obviously, a remarkably clear telephone line must be used in order not to distort the short and long telegraphic buzzes.

Pocket Book Radio Set.—A radio receiving set shaped like a small book has recently appeared in England and has attracted considerable attention because of its novelty. It operates on the variometer principle, with the covers of the "book" more or less closed so as to change the wave length of the receiving circuit. A crystal detector is included in the backbone of the "book" and the windings are inside the covers. This little radio set is said to be quite effective on an outdoor temporary aerial. It has a range of from 600 to approximately 2,500 meters. A pair of telephone receivers is used in conjunction with the "book."

Conductor-Directed Radio.—The Telefunken Company in Germany has developed into commercial form a system for wireless telephony especially adapted for intercommunication between high-tension stations at great distances. The signals, talk, etc., are not transmitted by ordinary wireless, states *Electrical World*, but the property of a conducting wire to direct the electromagnetic waves and thus cut down energy dispersion is made use of in the following way: An ordinary set for wireless telephony, with vacuum tube oscillators for producing continuous oscillations, feeds into a small antenna hanging between two transmission-line poles parallel to the high-tension conductors. At the receiving end of the line there is a similar antenna connected to wireless telephone receivers. Two-way communication may be obtained either by using two antennæ at each station or else by coupling to the same antenna one receiver and one transmitter, tuned to different wave lengths. Experience shows that the energy will follow the transmission conductors without much dissipation so that very great distances may be covered with a quite limited primary energy.

Science

$1,000 for an Essay on Roentgen-Ray, Radium or Radioactivity has been offered by the American Roentgen Ray Society.

A Nine-Foot Skeleton.—On opening a mound near Greensburg, Pa., the curator of the Carnegie Museum of Pittsburgh, Dr. Holland, unearthed a skeleton between eight and nine feet tall. The mound was 100 feet long and more than 12 feet high. The most interesting feature in the recent excavation was the mummified torso of a human body at least 4,000 years old. The parts of the skeleton were shipped to the Carnegie Museum.

A Museum Genius.—We learn with regret of the death of Dr. F. J. V. Skiff, director of the Field Museum of Natural History in Chicago. Though not a scientific man, he showed the most wonderful ability as an organizer and executive of museums and his advice was widely sought. He began life as a newspaper man. He was Deputy Director General of the Columbian Exposition and at its close he succeeded in raising funds to purchase the Fine Arts Building and also bought many of the exhibits. Marshall Field left $5,000,000 in his will for the new building the museum now occupies.

Human Palaeontology.—The Institute of Human Palaeontology founded by the Prince of Monaco, was recently opened in Paris. The previous studies of Prince Albert of Monaco have been along the lines of marine biology and oceanography, but he has also been interested for over twenty years in prehistoric man and he has financed many exhibitions which tended to throw light on the character, art, life and environment of prehistoric man. The building was approaching completion when the war broke out and it has now been declared open. The endowment is 2,000,000 francs.

The Swiss Lakes Disgorge Relics.—The recent drought in Switzerland has lowered the lakes so much that archaeologists are having a great opportunity to examine the old lacustrine or pile dwellings which date back to the Stone Age. Old pottery is being discovered in two lake dwellings revealed on the shores of Lake Neuchatel, says a cablegram to the *New York Times*, and hundreds of piles in perfect preservation and on which these dwellings originally rested are now clearly visible. Many persons have volunteered help for excavating the remains of these ancient dwellings, which, according to Dr. Keller-chief, the Swiss authority on the subject, ceased to be inhabited about the first century of the Christian era. Numerous boats, which apparently were wrecked and sunk in past times, are now visible.

Geography Comes into Its Own.—Clark University, Worcester, Mass., is to have a "School of Geography." Geographical Research may be regarded as one of the useful products of the war, as the American people now have an international point of view. Our further growth, perhaps our peaceful existence, depends on our judgment in dealing with the other peoples of the world. Research work in the field of geography is very much needed all over the world, so this "School" innovation will be warmly welcomed by thinkers. Graduate geography is the keynote. If it had not been for the books and maps of the American Geographical Society, we should have cut a very poor figure at the Versailles conferences. This Society will also establish a School of Surveying under the direction of the celebrated explorer, Dr. Alexander Hamilton Rice. It is proposed that graduates of the school shall be engaged in part in field surveys of high quality from which there will result improved topographic data for the regions selected for geographic study.

Even State Seals Do Move.—The State of Kansas is no longer satisfied with the old seal, showing a log cabin with a farmer walking with a plow of the vintage of 1850, while in the distance is an immigrant train going down the trail, and a primitive steamboat cleaving her way through a rippleless river. The new seal calls for an eight-shovel tractor plow, a twelve-room house in place of the log cabin, a twin-six touring car instead of the ox-train and a limited train to replace the steamboat on the Kaw. The Latin inscription is all that remains after the wave of progress has passed over the seal. We are used to such innovations in postage stamps, but such liberties taken with a State seal are unheard of. These monstrosities of the die sinker's art are very awful and we hope that other State officials will take their pen in hand and draw new designs likewise. It is a strange fact that the seals of Connecticut, Maryland, Massachusetts and New Hampshire do not bear their names plainly in English, if at all, nor does the Great Seal of the United States.

Engineering

A Large Indian Undertaking.—A water supply scheme is being carried out to provide water to the Jharia coal fields in India. The plans include a masonry dam at the reservoir, filter beds, a main aqueduct (which includes a tunnel 2,200 feet long through rock) and underground reservoirs.

Light Railways in New Zealand.—The Minister of Public Works announced in his annual statement to Parliament that the proposal to construct privately owned light railway lines in different parts of the Dominion to connect up rural sections with the Government main trunk line would be encouraged and efforts made to push the project. The construction of these lines will call for a large amount of material as well as construction machinery and rolling stock.

Disk Bearings for Railroads.—It is reported that the Swedish State railways recently placed an order with a native company for car axles, bearing boxes of cast iron with disk-bearing stamped cylinders and nuts, and it is not believed unlikely that this order will be the forerunner of others. It is expected that disk bearings will soon come into general use upon Swedish railways. It is stated that extensive trials were conducted between Stockholm and Goteborg before it was decided to adopt these bearings.

Increasing Use of Concrete for the construction of dwellings is noted in various parts of the world where lumber is not over plentiful, especially lumber suitable for building purposes. The manufacture of concrete blocks with which concrete houses may be built with speed and economy is attracting much interest in even such remote districts as British Malaya as a means of relieving the house shortage. It is reported that several municipal bodies are erecting the necessary plants for turning out these blocks.

Wooden Buildings in Europe.—The serious housing shortage in several European countries has caused the extensive introduction of wooden houses. Stone and brick are the favorite building materials of most European countries, and Europeans do not take kindly to wood except through dire necessity. Were the exchange more favorable, there is no doubt but that heavy orders for ready-cut houses would be placed with American manufacturers. As it is, the demands of Europe are being met by French, German and Austrian manufacturers.

Calcutta's Port Improvements.—Facilities of access to the port of Calcutta will be greatly improved by the construction of the Grand Trunk Canal. According to an issue of *Finance and Commerce*, the canal will be 22½ miles long and between 250 and 400 feet wide, extending from Garanguria to Kulti. The canal will include an inland harbor at Manicktolla, which will relieve the congestion on the Hooghly. The harbor and its connected basins will provide a frontage of nearly 14 miles and it is believed that these facilities, and the reclamation of a large waterlogged area in the vicinity of Calcutta will afford an avenue for the expansion of the city and the creation of a new industrial center in the neighborhood.

Compulsory Labor for Engineering Work.—According to information from Sofia, Bulgaria has passed a law by which labor is obligatory both for men and women. This labor can be utilized in many ways, including the construction of roads, railways, canals, aqueducts, improvement of rivers and streams, installation of telephone and telegraph lines, preparation of various building materials, the planting and exploitation of forests, work in the various domains of the State, districts, or communes, cultivation of kitchen gardens, raising of silk worms and of bees and cattle, fisheries, work in mines and factories, conservation of food products, weaving, etc. The demobilization of the Bulgarian army by virtue of the recent treaty has rendered this law necessary.

Pittsburgh's Vehicular Tunnels which are to pierce the South Hills will be the largest highway tunnels yet built, with a length of 5,715 feet. Ventilation arrangements are of special interest as this is the first long tunnel in which automobile exhaust has had to be dealt with. There are two tubes, each providing for two lines of traffic with space for street cars, the traffic in a tube to be all in one direction. The maximum estimated traffic is 1,690 vehicles per hour in each direction, mostly passenger vehicles. Ventilation plans are being based on special tests, conducted by the U. S. Bureau of Mines, of automobiles for carbon monoxide emission, and of the susceptibility of human beings to that gas. Air will be blown in at one end by lateral nozzles in the direction of traffic. A pumping plant for each tube distributing normally 200,000 cubic feet over the 468 square feet of cross section will give an air current velocity of six miles an hour.

The Falsework for a Big Dam

Some Unusual Trestles Employed in This Department of Concrete Construction

By J. F. Springer

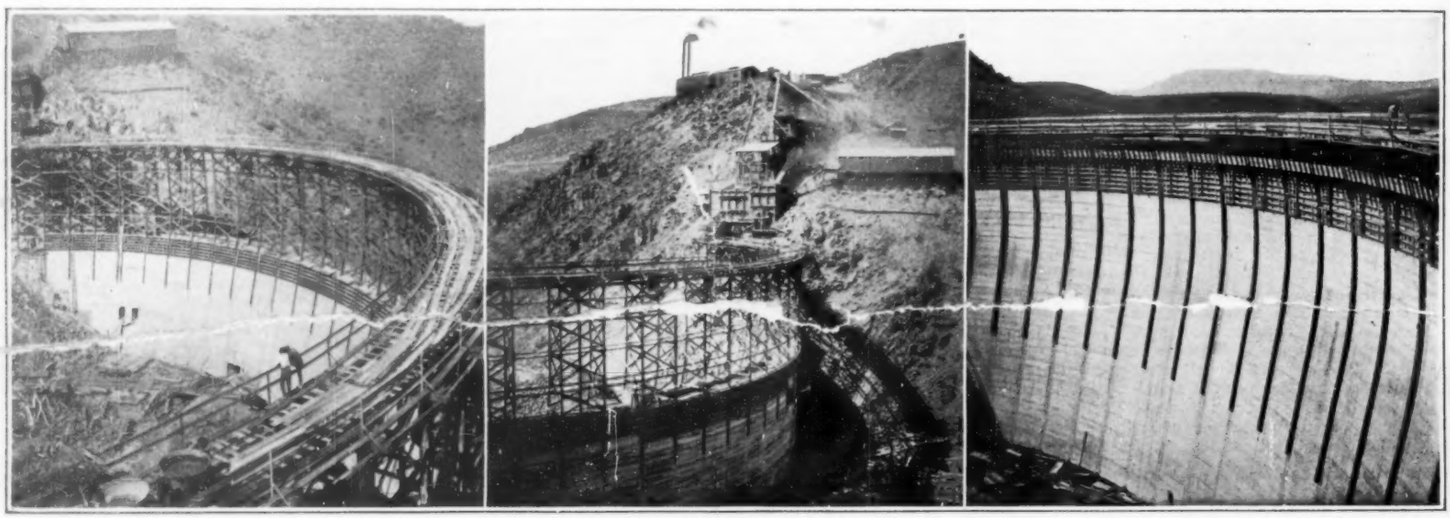
ONE of the hindrances to a still greater use of concrete is the expense of the auxiliary construction. Thus, the work may be so planned that a very heavy expenditure will be required for the forms. Or, the method of supplying concrete may involve a great outlay for trestles or other auxiliary construction. But engineers are driven to invention under stress of necessity and now and then develop a system of operating that tends to cut down the cost. Two recent cases illustrative of rather i vel methods of dealing with the trestle work problem have occurred in the Far West. Doubtless the pressure of costs contributed to the adoption of these features of the methods of handling the work.

Both instances relate to single-arch dams. Such structures are built with the convex face upstream, the object in view being to resist the hydrostatic pressures by means of arch action. The horizontal thrust of the water is not at all unlike the vertical load on an ordinary arch. Where the site is a V-shaped canyon having pretty steep sides, the single-arch dam may well be considered as possibly the best type of dam to use. Where all the conditions are favorable, a single-arch dam is apt to be quite economical because of the reduction of concrete made possible by the replacement of the mere weight by the arch action of the structure. However, in order to take full advantage of the economies possible with the single arch, it is necessary to manage the curvature with some precision. Naturally, this requirement will transfer itself to the forms. In short, the proper shaping of an arch dam gives rise to demands that can only be met by a skilful and precise construction of forms.

Recently a hydro-electric power development in California required the construction of a dam to impound water. It was decided to erect a single-arch structure. On the upstream face, the height was 108 feet; and the radius of curvature of this surface was 205 feet. The construction was facilitated by a rather novel use of trestlework. When the foundation had been completed, a great trestle structure was run up. It was so set and so shaped as to inclose the space which the dam was to occupy. It was to provide not only a means of delivering concrete for the dam but also a backing for the forms whose duty it would be to give shape to the faces of the concrete structure. The concrete was delivered at various higher and higher levels as the concreting went on. The mixing plant was set on the hillside a short distance upstream from the dam. Its level was selected so that the feed hopper could readily be served from a track which connected with the stone crusher on the downstream side of the dam, and so that it might discharge by gravity to the lower levels of the dam. The higher levels would be served differently. An elevator tower was erected close by the mixer. By means of it, concrete could be hoisted to proper elevations and then delivered to selected levels of the trestlework. At these levels, tracks were laid and on these hopper cars run back and forth. These cars were hauled by gasoline locomotives and delivered their contents of concrete through openings between the rails to chutes which led to the proper delivery points. Naturally, gravity carried the concrete down the chutes whose maximum drop was limited to about 50 feet. The concrete would often go with a rush; but it is understood that the consequent violent delivery to the mass of concrete already in place tended to a consolidation, and that the new concrete did not tend to separate into its constituents as it flowed along.

The utilization of the trestle as a backing for the forms was carried out substantially as follows: In setting up the trestle, the various bents of trestle posts were so arranged that the batter post would at no point be closer than 1 foot to the concrete surface that was to be. By locating the bents at intervals of 15 feet and predetermining for every 10 feet of height the precise distances between batter and concrete, the bents were suitably set. The distance between batter posts at the bottom was a maximum of 30 feet and at the top an interval of 10 feet. It will be understood that this trestle was erected to the full height at once and stood upon its own feet, as it were.

The second instance of the rather novel use of trestlework is to be distinguished from the first in that the feet of the posts did not rest on anything at all. They straddled the partly constructed dam, and, since the legs spread somewhat, support was supplied to their inner sides by the concrete surfaces and by certain anchors in the concrete. This account applies particularly to the trestle used in building the upper half of the dam. The illustrations show pretty clearly how the trestle rode the masonry.



Three views of the Warm Springs dam, two during construction and the third when nearly complete, showing the huge trestle employed as an auxiliary in the work of erection

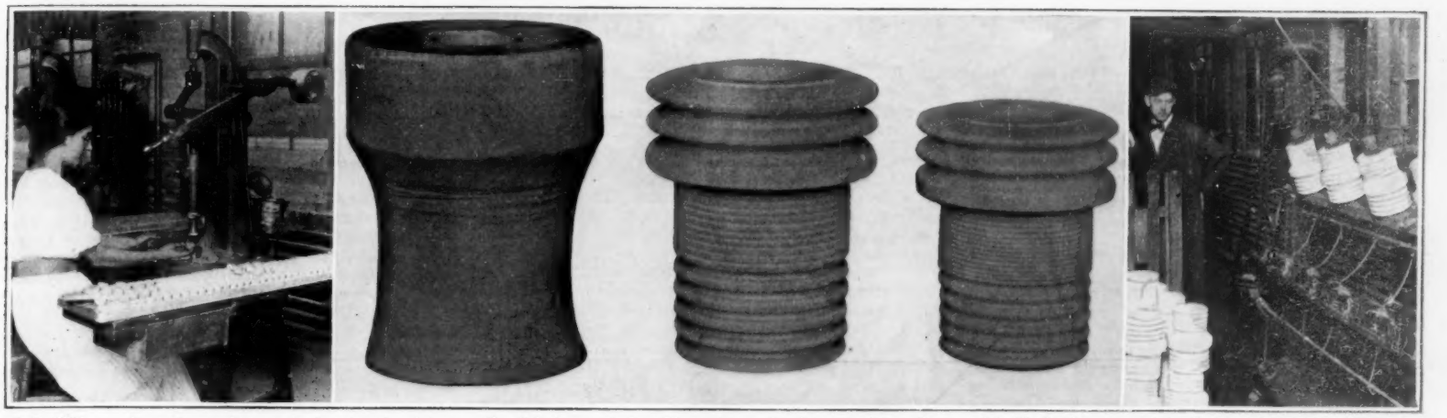
This structure, the Warm Springs Dam, is located in the eastern part of Oregon and forms part of an irrigation system. Some 40,000 acres of land are to be additionally supplied, or else altogether reclaimed to farm use, by the proper utilization of the 170,000 acre-feet of water it has the duty of impounding. However, it is not yet certain what is to be done with a certain portion of the water. It may be used for a part of the said 40,000 acres; or it may be sold to an adjoining district.

From the underlying rock to the crest, the dam has a maximum height of some 81 feet or more. At the base it is only 27½ feet thick and near the crest only 8 feet. This is a very thin section, and is in marked contrast to what a gravity section would show. However, in 1916, when the dam was yet in contemplation, it was estimated that a single arch structure would cost about 93 to 95 per cent of what would be the expense for the ancient type. The gravity type was at that time recommended, the excess cost being so moderate. However, construction costs kept on advancing, so that the advantage of the single-arch type became quite decided.

The new dam spans the gorge of the Malheur Riv... and forms a circular segment of perhaps 140 degrees. It stands upon bed rock, but not exactly at the site originally determined upon. The preliminary work of excavating for the foundation indicated a deeper level for bed rock than was ultimately found necessary. That is to say, it was discovered that by shifting the site a little upstream, bed rock would be found closer to the surface. In constructing the dam, there has been recognition of the possibility that eventually the foundation rock may need treatment to render it impervious to water. Test holes put down seemed to indicate that there were no open seams. This tightness was deduced from the fact that in no case did water forced down through hollow bit and drill rod fail to reappear, when the hole was at the time in the bed rock. However, in case leakage develops after construction, there will still be a remedy at hand. In the body of the dam near the downstream face a series of vertical holes has been arranged. These are at intervals of 6 feet and are lined with 2-inch piping. In case of need, through these holes drilling may be carried on and the bed rock pierced for a distance. Then, Portland cement grout may be put down under practically any pressure desired up to say 1,000 pounds per square inch or more. This arrangement of drilling and grouting pipes is something like the case of a fairly tall building on Broadway, New York, where the jacks are already in place, if the structure, which is a pretty narrow one, should at any time show signs of uneven settlement. In both cases, the remedy could be applied, however, even if the precautionary measures had not been taken. Concrete may be bored by core drills as readily or more readily than granite, and jacks can be set at any time. However, with tubes and jacks in place, quicker action becomes possible.

There are two principal types of design for single-arch dams. In the one, the central angle included by the arc at one level is the same as the central angle included by the arc at any other level. Such dams belong to the constant-angle type. In a V-shaped canyon, with the span becoming less and less as the bottom is approached, the curvature necessarily becomes sharper and sharper because of the requirement that the central angle included shall not vary. In the other variety of design the radius of curvature once established is maintained from base to crest. In the present case, the dam is of the latter type, the degree of curvature being kept constant or substantially so. All the foregoing relates to the upstream face, the surface which receives the load. The single arch dam of constant radius presents to the impounded water a cylindrical surface; while the dam of constant relative length of arc presents a face which deviates from the vertical and projects more and more upstream as the span decreases toward the base. In one of the views, the truly cylindrical form of the convexity is plainly apparent. The dam is quite vertical on this

(*Continued on page 217*)



Left: Filling a die with porcelain ready for stamping into a wall-switch base. *Center:* Three stages of a large insulator—the porcelain blank, the same cut to shape, and the finished insulator after firing. The shrinkage in firing has to be calculated to the 64th of an inch. *Right:* Testing insulators under a current of 75,000 volts. The wavy white lines on the insulators of the lower row represent the effect on the photographic plate of electric sparks running over these pieces

Making and testing porcelain insulators to keep the electric current where it belongs

Making Electric Insulators of Porcelain

By Ralph Howard

MILADY gazes admiringly at the china that reflects the light from the electric dome over the dining room table, and wonders how such marvels of ceramic art can be wrought. But she gives no thought to the humble porcelain insulator—the Cinderella of the family—without which there would be no electric light in its modern form. It may seem that almost anyone could mold a porcelain wall-switch base, a cleat used in wiring buildings, or some of the simpler forms of insulators. But when it comes to making them so that after the shrinkage that results from subjecting them to a temperature of upward of 2,642 degrees Fahrenheit, they will still be within the dimensions required, it is not so simple. Nor is size the only thing that has to be considered. The porcelain must be so mixed, molded and fired that it will withstand, in some cases, hundreds of thousands of volts without breaking down and allowing the current to pass through it.

Porcelain is made of potters' clay, ball clay, feldspar and flint, the two latter being in the form of fine powder. These are mixed with water, the coarse particles strained out, and the resulting cream-like batter goes to the filter presses where most of the water is pressed out and it emerges as solid, damp cakes.

There are now two methods of procedure, the dry process and the wet process. The dry process is used in making the devices to insulate the lower voltage currents—such as, for instance, building-wiring equipment—while the wet process, which permits making a denser structure, is employed for insulators for high-voltage power-transmission lines, and in transformers, oil switches, etc.

The making of wall-switch bases, cleats, and other small porcelain insulators is a fascinating process. The damp cakes that come from the filter press are dried until just enough moisture is left to press them. Then they are reduced to a loose, damp powder, and this is dropped into oiled dies shaped according to the design of the article to be made. Long rows of machines, each stamping out a neatly molded piece at the turn of a lever, mold thousands each in the course of a day. The insulators are taken from the press and placed in neat rows on pallet boards and dried by steam anywhere from a few hours to several days. Then the little rough edges or burrs are removed and the insulator is ready for glazing.

In making wet process porcelain, the cakes from the filter press are given a kneading that eliminates the air and mixes the mass together. From the machine which completes this process it comes in the form of a cylindrical mass, ready to be fashioned into any desired shape.

Some is put into a plaster of paris mold and pressed into the pattern wished. Another piece will be placed on a horizontal wheel operated by a motor—an adaptation of the ordinary potter's wheel. When it is set on the wheel it is just a plain, ordinary looking cylinder of yellowish porcelain. But under the manipulation of a skilled operator it quickly takes on a graceful appearance as shown on our cover. The touch of a little implement cuts a series of grooves, or perhaps a continuous thread, in the side, and ribbon-like shavings of porcelain fly from the article being turned, crumbling as they fall. When the work is done, what was a mere cylinder has become an accurately measured insulator, conforming to careful specifications.

Where a curve conduit or pipe is wanted, the process is simplicity itself. Liquid porcelain mixture is poured into a plaster of paris mold shaped like the outside of the conduit desired. The plaster of paris absorbs the water from the mixture adjacent to it, leaving a shell of porcelain next to the mold. The water in the fluid porcelain farther away from the sides of the mold is not absorbed, and hence the mixture remains in a liquid state. When the walls of the conduit are sufficiently thick, which depends on the length of time the mixture has been in the mold, the fluid is drawn off and the conduit is taken from the mold and dried.

Great care has to be used in the drying. The porcelain must dry evenly, and therefore not too rapidly. Steam is turned into the drying machines to insure sufficient humidity. Gradually the amount of steam is decreased and the heat is increased. Thus the outside is kept from cracking and the drying process proceeds uniformly throughout the article.

Insulators made by the wet process are, in some cases, five and six feet high, and upward of two feet in diameter. The largest are not, however, made in one piece. Sections are turned out and then piled up as the housewife stacks plates, and the heat in the kiln, when they are "fired," fuses them into one solid piece.

(*Continued on page 219*)

A Measure of Interior Lighting

By S. R. Winters

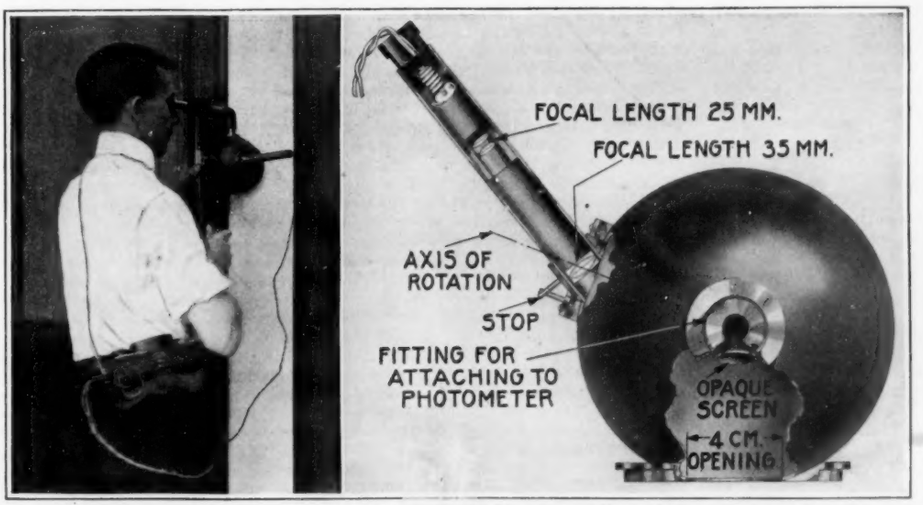
A NEW instrument for measuring the light reflected by room walls, technically described as a portable reflectometer of the absolute type, has been designed by A. H. Taylor, until recently associate physicist of the National Bureau of Standards. An achievement already credited to the device, resulting from experimental work for the government, is that of giving additional proof as to the light-reflecting capacity of magnesium carbonate. The value of a particular block of the substance was proven to be 99 per cent whereas the previously accepted figure was 88 per cent.

The reflectometer, simplicity being one of its virtues, was evolved on the theory that if a light is projected onto the inner wall of a small hollow sphere, painted with a diffusely reflecting white paint, it can be shown that the illumination of the surface by reflected light only will be equal in intensity at all points. A small portion of the surface is cut away, leaving a hole over which the surface to be tested is placed. At another point on the sphere, 90 degrees from this one, there is a small hole through which the opposite wall of the sphere is viewed by means of a portable photometer. The spot under observation is screened from the test surface by the use of a small opaque screen. Therefore, when the light is projected on to the test surface, it must be reflected from it and from the sphere walls once each before any of it can reach the observation point.

The newly designed instrument for measuring the light reflected by room walls consists of a lighting tube, capable of being set at an angle to the sphere surface, rotating about an axis normal to the surface of the sphere. Such an arrangement permits the direct light to be thrown on the test surface or the sphere wall as may be desired. An efficient lens system affords a narrow beam of light without scattered rays. A uniform, sharply defined spot of light, 2.5 centimeters in diameter is the result, thereby requiring only a small opening. A 2.8 volt opal-back flashlight lamp is used in the tube. Its low voltage makes the instrument of a portable nature, and possibly adaptable to any reliable type of portable photometer. The elimination of the battery-meter set and the substitution of a three-cell flashlight dry battery, and miniature resistances, would further contribute to the compactness of the reflectometer.

According to claim, the superiority of the absolute type of instrument over one giving relative values is in the non requirement of a standard surface and the unnecessary qualification of lamps or sphere surface remaining constant from day to day. Experimental work with the new reflectometer

(*Continued on page 219*)



New instrument for measuring the light reflected by room walls, and the manner of its use

Brief Facts About Money

With a Suggestion for Making It Better Able to Perform Its Work

By Charles E. Duryea

WITH the most money per capita we have ever had, we find today a very high interest rate and a shortage of money, which results in unemployment, slack business and failure to get the profitable trade a large part of the world is begging us to take. Why are these things? A few facts about money will explain.

Money—paper money—is an invention, designed to transfer wealth. Money, by replacing barter, speeds up business. It is the great business facilitator. It may rightfully be classed with the mail, telephone and telegraph services and with roads, streets and canals. But too often we think money the concern only of the money handlers and fail to know for ourselves whether we are getting from it the service it can and should render.

When the available trails and waterways failed to carry our commerce we built larger and additional ways. So with every aid to business except that most universal one—money. Why not with money? Because few people understand its proper function. It was near the end of the last century before our people regarded paper as proper money, and only in this century have we learned that paper money, issued by a sound and honest government and secured by proper redemption provision, is the best money—better than coin. In every crisis from time immemorable coined money has taken flight and left paper money to do the work.

We have rightly learned that the Government should print money, protect it from counterfeiting, provide for its redemption and in several ways advance the interests of all. These things cannot be so well nor so safely done by individuals nor even by States, as the unsatisfactory experiences with State banks of earlier days show. The Federal Reserve and Farm Loan acts are great steps forward toward a proper supply of money but they leave much to be attained. What more can be done?

It is axiomatic that neither men nor nations should have more than they produce—the results of their labors on their natural wealth—and equally axiomatic that men willing to work in order that they may secure what they desire should not be deprived of the opportunity. Yet how often do we find great lines of unemployed and factories and farms idle. Truly we then need a business facilitator and the greatest of all is money.

Money was originally simply a commodity that bartered with great ease. Because the farmer did not need shoes, the shoemaker traded his shoes for a piece of gold and traded the gold for the farmer's grain. The farmer in turn traded the gold for what he desired. This illustrates two things—that money facilitates business and that one piece of money will serve for many transactions. Many commodities have been used for money.

In the development of this invention the accepted commodities became fewer until gold has been generally adopted. All these commodities had faults, such as unhandiness, depreciation, counterfeits, etc. Gold has fewer faults than most but it is scarce, too scarce to meet the money needs of the world. If it was not scarce it would be less valuable, so even greatly increasing its quantity would not help. Its value is fixed by its use in the arts. It fluctuates in value just as does any other commodity, but since a legal dollar is 23.22 grains of gold this fluctuation cannot be stated in dollars.

If we could make gold from some cheap substance its value would fall at once. Clearly then gold money and money based on gold is at the mercy of the gold miner or the accident of gold discovery. Many attribute the dark ages to lack of money to do business with.

Spain's American gold was one of the great influences that set Europe ablaze with business energy and made Spain master of the world. Every discovery of gold has brought a business boom. The great progress in every line of the last generation has been preceded by a rapid yearly increase in the production of gold. Many are the evidences of this fact. Space does not permit giving more.

The world did not need gold but money. It clamored for gold because it used gold for money. That is the case today. Lacking gold we use "credit instruments." It is clear that there is not and never can be enough gold to serve fully our money needs. If there were more gold it would have less value. It is also clear that one unit of money will serve to facilitate many business exchanges so there will ever be far more commodities than there is money. Further in our attempts to provide paper money based on gold we have constantly reduced the gold set aside to redeem the paper until we are close to the limit of safety, while other nations find their paper issues far beyond any possibility of redemption. Clearly it is time to set our money right so that world business may be facilitated and we may get that prosperity rightfully ours.

The way to do this is easy but like all good things it is so simple that it is rejected by the very people who should be the first to accept it. Instead of basing our money on one agreed commodity which cannot be of sufficient amount, we should base it on an agreed quantity of all standard commodities. These are certain to exceed our needs many times so there need never again be a shortage of money. And nations having no gold can still have a sound money. We should do this now.

Today the purchasing power of a dollar is that of 23.22 grains of pure gold, because a paper dollar can be exchanged for this quantity of gold. For 25 years past this purchasing power has been falling. "Prices have risen." The schoolma'am who banked $1,000 ten years ago cannot buy, with the principal and accumulated interest, so much today as she could then. Our wrong system has robbed her. She put into the bank a certain purchasing power. In all honesty she should get back that purchasing power plus an agreed addition for interest, should she not?

In years gone by the workman hired to work for, say, $2 per day. His family budget permitted him to meet their needs with this wage. But rising prices changed this. He had to have more money. To get it he "struck." His cause being just, he won. The employer to protect himself added a larger margin to his price. Prices again rose and again the worker "struck." Twenty-five years of this resulted in a constant turmoil with much waste and industrial warfare almost constant. Then the World War made matters still worse. Surely we have no right to expect otherwise.

Prof. Irving Fisher of Yale offers us a plan—not new with him and certain to be adopted some day. He would base the dollar not on gold but on a selected list of standard commodities. One such list of over 300 commodities is made by the Bureau of Labor. The average quantity used yearly by the average person is known. The price multiplied by the quantity gives the base figure. The average of these products gives an "index number." If this index number rises one per cent it is clear that the dollar should be made one per cent bigger so it may still buy the same quantity of these standard commodities. To make this dollar do this we must add to the gold it represents. In other words change from month to month or as often as need be, the legal amount of gold that constitutes a dollar. Since there is little or no gold in circulation this is a matter of law and not of coining. But it gives us an honest dollar; one that retains its buying ability. Both employer and employe can work in peace with a definite purchasing power. Further details of this can be had from Professor Fisher's books and magazine articles.

"But we cannot redeem in 300 commodities," you say. Truly. Nor do we need to. As each month the index number is published any one can know the quantity of gold constituting a dollar and our dollars may as easily be redeemed in this quantity as in the present quantity. The Fisher plan simply separates the two requisites of money. It proposes to measure money by the index number and redeem it in gold and its value will still be expressed in gold but that value will show the fluctuations which gold cannot and does not escape. We will then know what we are about instead of—ostrich-like—trying to avoid seeing that gold does fluctuate.

"But," again you ask, "if we redeem in gold how may we safely create more money than we now have?" A proper query. Having separated the purchasing power from the expression of value by basing one on the index number and stating the other in gold we at once see that paper money is something to exchange for commodities and not for gold only and that it would be just as satisfactory for our Government to redeem a dollar with silver or tin or any nonperishable commodity provided that the commodity given will, on the day of redemption, exchange for the then legal amount of gold, in the open market. By such an arrangement we may for the first time in the history of the world have as much money as we need and know beyond doubt that it can be easily redeemed as fast as presented by valuable commodities and in fair and honest amounts. This certainty would quiet any fears for the stability of our money. It would permit issuing as much money as we need, thus lowering interest rates. How low one need not say. In times past when money was plentiful our Government has borrowed as low as 2 per cent. Since the war began call money at New York has been as low as 1¾ per cent. Certain it is that such rates would boom business in every line and would make our great land the farm, factory and bank of the world. It would help our producers to finance their customers in the war-stricken and less developed parts and start a flow of goods our way to meet the interest payments as well as pay the principal. It would benefit the world and show them how to get on their feet with financial soundness. There has never been a time when it was needed so badly and upon the people of the United States the burden rests. The ones who are making great profits from high interest rates can hardly be expected to take the first step.

When we have "Stablized the $" as Fisher proposes and arranged for ample and certain redemption we may take another step—direct issue to the user, provided he gives ample security. We have learned the value of free streets and roads. We carry the mails practically at cost, to facilitate business. We should encourage the small producer on farm and in factory and also the home owner by advancing money, amply secured, at the lowest possible interest and on time to suit.

This would make owners out of renters; solve the housing problem; correct the ever-growing labor problem by making proprietors of the more progressive workers; set at work many who now live by owning; and free much private money from the soft snaps it now enjoys and send it hunting investments to the ends of the earth. No single simple change offers such gains as this improvement in our money.

MONEY, next to language, is our most used institution. Mr. Duryea, whom many of our readers will recognize as one of the pioneers of the automobile, has ideas on the nature of money and the way in which money problems should be met, which, while he is certain that they are right, he recognizes are rather controversial in their nature. We have agreed to let him make these opinions public through our pages, and he has agreed to attend to all the controversy which may arise from such publication. If you don't agree with what Mr. Duryea says, therefore, don't write to us about it; write to him, at 3528 North 18th St., Philadelphia. Some of the more significant comments which he receives he will probably pass on to us for appearance on our correspondence page; but the immediate consequences of the present article are to be on his head and not on ours.—THE EDITOR.

Cadmium in Brass

MUCH work has been done in the United States on the question of cadmium in brass and we now have the opinion of a French investigator writing in the *Revue de Metallurgie*. The conclusion which he has reached from studies upon alloys containing cadmium up to 5%, copper 70%, and zinc from 30 to 25% are:

First, that 1% of cadmium in brasses containing from 60 to 70% of copper has little, if any, effect. Resiliency suffers, however, if more than 1% of cadmium is present.

Second, changes noted in the mechanical properties are thought to be due to the probable occurrence of cadmium uncombined in the alloys.

The Einstein Prize Winner

WE had held out the promise of a biographical account of Mr. Bolton, the winner of the Eugene Higgins prize of $5,000 for the best popular essay on Einstein's theories of relativity; and we are able to present a performance which runs past the promise. In response to our request for a few details, Mr. Bolton has supplied an autobiographical sketch which we are moved to print just as it comes to us. Mr. Bolton says:

"I was born in Dublin in 1860, but I have lived in England since 1869. My family belonged to the landed gentry class, but I owe nothing to wealth or position. I was in fact put through school and college on an income which a workman would despise nowadays. After attending sundry small schools, I entered Clifton College in 1873. My career there was checkered, but it ended well. I was always fairly good at natural science and very fond of all sorts of mechanical things. I was an honest worker but no use at classics, and as I did practically nothing else for the first four years at Clifton, I came to consider myself something of a dunce. But a big public school is a little world. Everyone gets an opportunity, often seemingly by accident, and it is up to him to take it. Mine did not come till I was nearly 17. As I was intended for the engineering profession, I was sent to the military side of the school in order to learn some mathematics, at which subject I was then considered very weak. This was certainly true, as at that time I barely knew how to solve a quadratic, I was only about halfway through the third book of Euclid, and I knew no trigonometry. But the teaching was inspiring, and I took readily to mathematics. One day it came out that I had been making quite a good start with the differential calculus on my own without telling anybody. After that all was well. I left Clifton in 1880 with a School Exhibition and a mathematical scholarship at Clare College, Cambridge.

"After taking my degree in 1883 as a Wrangler, I taught science and mathematics at Wellington College, but I was attracted by what I had heard of the Patent Office and I entered it through open competition in 1885. During my official career I have been one of the Comptroller's private secretaries and I am now a Senior Examiner. During the war I was attached to the Inventions Department of the Ministry of Munitions, where my work related mainly to anti-aircraft gunnery. I have contributed, and am still contributing, to official publications on the subject.

"I have written a fair number of essays on various subjects, even on literature, but my only extra-official publications relate to stereoscopic photography. I read a paper on this subject before the Royal Photographic Society in 1903 which was favorably noticed by Dr. von Rohr of Messrs. Zeiss of Jena. I have also written in the *Amateur Photographer*.

"I have been fairly successful at athletics, and I am a member of the Leander Club."

"Feb. 14, 1921. "LYNDON BOLTON."

Current Scientific American Monthly

IN variety and number of subjects covered the SCIENTIFIC AMERICAN MONTHLY for March is unusually rich. There are twenty-six major articles and twenty-nine shorter articles and notes, in addition to eight departments which give a survey of the progress of science and technology.

The leading article in this issue is one of the essays of the Einstein prize contest. The judges, in making their selection, were obliged under the conditions of the contest to select an essay which would be within the grasp of the general reader. Naturally there were some essays which, although excellent from every other viewpoint, failed to measure down to the standards of the general reader as interpreted by the judges. Among these essays, there was one which was a most illuminating discussion for the man equipped to read it with full understanding, but which had to yield first place to Mr. Bolton's essay because it was considered somewhat above the average layman. This essay was written by Dr. Francis D. Murnaghan, and it appears in the current issue under the title "The Quest of the Absolute."

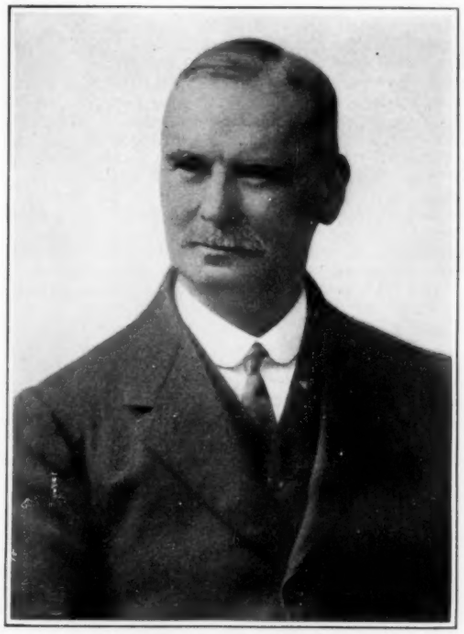
Great interest has been aroused in recent years by the discovery of paintings in ancient caves, which undoubtedly were made by artists of the glacial period. Most of these paintings have been either of symbolic nature or else have portrayed animal life. Among some recently discovered cave paintings in Spain, there are pictures of human beings done in a very realistic manner and in one or two cases there are actual portraits, although they may be regarded as "non-individual," because of the omission of details. Reproductions of some of these figures and an interesting discussion of them are to be found in the March issue.

One of the truest measures of the civilization of any race is to be found in its of traffic on water as well as on land. There are some primitive tribes which are confined to comparatively restricted regions, because they have not yet discovered or invented the simplest means for crossing rivers or stretches of water. Other tribes on the contrary have shown considerable ingenuity in the construction of bridges; consequently the bridge forms a very good test of civilization. An exceedingly interesting article on this subject describes trestle, truss, cantilever, suspension and arch bridges made by natives of such materials as they had at their disposal. These primitive engineers show, in many cases, a remarkable degree of ingenuity and technical ability.

Recently Columbia University has instituted a series of psychological examinations to test the mental capacity of students. In view of this our readers will be interested to learn what A. T. Poffenberger, Assistant Professor of Psychology at Columbia University, has to say on "Psychological Examinations." He describes practical methods of measuring vocational fitness.

The article is profusely illustrated with photographs and diagrams.

We are wont to think of the devil-fish as an octopus. As a matter of fact this name applies rather to the giant Manta, which sometimes reaches a length of 12 feet and breadth of 20 feet. The curious habits of this gigantic denizen of the sea are entertainingly described.



Lyndon Bolton, winner of the Einstein Prize Essay Contest

The coming visit to this country of Madame Curie, the famous discoverer of radium, lends particular interest to an article on "The Radium Institute in Paris," which describes that distinguished scientist's new radium pavilion and its scientific equipment.

At the present time the prevention of dust explosion is commanding the earnest attention of engineers of all classes in this country and abroad. The causes and prevention of explosion and the types of industrial plants affected are outlined by David J. Price, in which he brings out some newly discovered factors.

"Ancestors of the Liberty Motor" is the title of an interesting article by Dr. Carl W. Mitman of the U. S. National Museum. In this article he outlines the origin and development of the internal combustion engine from the latter part of the 17th century up to the present day. The article is illustrated with photographs of models in the Department of Arts and Industries of the U. S. National Museum.

M. Louis Lumière, who is well known for his work in color photography, recently presented an important communication before the French Academy of Sciences, concerning a new method he had developed for taking photographs of "solids in space." In other words, the photographs indicate three dimensions instead of two, in the manner of a relief map. This effect is produced by using a camera whose lens and plate holder, respectively, have rotary motions during the exposure of the picture. A complete description of the apparatus and a geometrical explanation of the principles involved are given.

Leonardo da Vinci, as well as being a world famous artist, showed remarkable talents as an inventor and his achievements in science and invention are described in an interesting article by A. A. Hopkins. Some of his original drawings are reproduced. An ingenius file-cutting machine, a marble-sawing machine, a traveling crane and a military engine—which was the forerunner of the mitrailleuse—were among the products of his fertile brain. Leonardo was also the inventor of the suspension wheel. This article will be supplemented in the April issue of the SCIENTIFIC AMERICAN MONTHLY by another on Leonardo da Vinci as an inventor of flying machines.

A Community Ice Plant

SOME Western communities in which ice is strictly a manufactured product are interesting themselves publicly in the subject of ice manufacture. There is a type of small district or city which justifies the establishment of one local ice plant, but does not contain room for two. The operator of the one ice manufactory enjoys the nature of a monopoly. Of course, ice can be shipped in, but ice is a very bulky and heavy commodity, and its free flow between communities, in commerce, is never apt to be very great.

Many communities have protested and complained a great deal about ice prices. One community, Lindsay, in California, has acted. A local plant was on the market, and last spring the local Chamber of Commerce got an option on it, organized the Lindsay Community Ice Company, sold stock to some three hundred local people, and took over the plant. Management of the enterprise was placed with the secretary of the Chamber of Commerce.

The first season's record of this company is illuminating. It is in the centre of a district where retail ice prices, platform basis, have been up around $1 a hundred. At Visalia, ice was 80 cents at retail, at Exeter 90 cents, at Portersville and Lemon Cove, $1. At Lindsay, the community company sold ice at 50 cents a hundred.

The plant manufactured 1,000 tons of ice the past summer. Granting consumers would otherwise have paid 85 or 90 cents, the company saved them something like $7,500. At this rate, the replacement value of the plant being $20,000 to $25,000, the plant would pay for itself in less than four years.

The plant has a capacity of 1,000 tons a year, and storage space for 100 tons. The low prices have stimulated demand, and the coming year the capacity will be increased to 2,000 tons, which the management says can be easily sold. Storage room for 1,000 tons will be put in. Farmers on trading visits to Lindsay are good customers.

The past season, the Lindsay community plant manufactured ice and put it on the platform for about $3.80 a ton. Retailing ice, however, it figured it must sell for 50 cents the cwt. in order to break even.

An ice plant requires considerable initial investment. The competition of private enterprise in local ice manufacture is not keen, and retail prices naturally are high. The community ice plant seems an obvious remedy for the situation, under some circumstances.

A Mathematical Prodigy

SOME years ago the London *Lancet* cited a remarkable case in which extraordinary ability in arithmetical calculation was associated with general mental inferiority, if not actual insanity. The patient was completely blind and was able to make elaborate calculations such as a square root of any number running into four figures in an average of four seconds and the cube root of any number running into six figures in six seconds; thus he gave the cube root of 465,484,375, which was 775, in thirteen seconds. These are mere trifles, however, compared with the following. He was asked how many grains of corn there would be in any one of 64 boxes, with one in the first, two in the second, four in third, eight in the fourth and so on in succession. He gave the answers for the 14th (8192), for the 18th (131,072) and the 24th (8,388,608) instantaneously, and he gave the figures for the 48th box (140,737,488,355,328) in six seconds. Further, on the request to give the total in all the boxes up to and including the 64th he furnished the correct answer (18,446,744,073,709,551,615) in 45 seconds. Such mental processes are particularly interesting in view of the fact that the patient cannot have any visual memories as he has been blind from birth. The same patient can give the date for Easter in any year, in the Gregorian and Julian calendars respectively and simultaneously.

Who Shall Work the Farms?—II

The Extent to Which the Labor Shortage Persists, and the Measures of Relief Available

By George H. Dacy

LAST week Mr. Dacy presented the first half of a discussion of the farm-labor shortage as experienced last year and as promised for 1921. In this article he concludes his remarks with a few more figures that go to establish definitely how serious the matter really is, and a few suggestions from those best qualified to judge how the farmer may best find his way out of the difficulties in which short help have plunged him.—THE EDITOR.

ONE thing is as certain as the millennium. It is that you cannot operate a farm or handle farm labor on an eight-hour-day basis. If the farm operates on a short-day calendar it simply involves the use of a double labor force. During the summer the average farmer has to spend from twelve to thirteen and in many cases fourteen or fifteen hours daily in the fields to handle his crops successfully. If his day is limited to eight hours, he performs only a little more than half as much work as he would do normally during the warm weather period. The rush season of haying and harvest activities emphasizes the necessity for capitalizing sunshine and daylight. These are the times when the faithful farm hands let their watches run down and do not wind them again until the period of pressure is over. During these seasons the eight-hour-a-day worker is about as useful to the average farmer as a couple of knitting needles would be to a litter of kittens. The man or boy who truly aspires to work on a farm this summer or who desires to aid in the food production operations initially must divorce himself from every shred of the idea that eight hours of daily work and employment on an average farm even occur in the same dictionary.

Dr. H. C. Taylor, in charge of the Office of Farm Management of the Department of Agriculture, who is intimately in touch with the farm labor situation in all parts of the country, told the writer that the feasible manner for the farmers to meet and defeat the critical farm help shortage was by using heavier machinery—as far as possible—and by utilizing the tractors which would allow one man to perform the work of two or three workers. Doctor Taylor said that Uncle Sam would work overtime in directing the labor from towns and cities to the most seriously straitened regions. He referred at some length to the bad effect which the contraction of credit has had upon the farmers' recent purchases of heavier machinery, power outfits and fertilizer. According to his opinion, throughout the wheat growing districts the labor recruiting service is organized efficiently and adapted for securing and distributing farm labor—as it becomes available—among the labor-impoverished farms of its locality. The farmers' organizations, the state departments of labor and the farm bureau federations are all working for the single end of promoting and increasing production as the laudable methods of reducing existent, inflated living costs.

In conversation with Mr. Asher Hobson, Assistant Chief of the Office of Farm Management, he brought out the fact that the abandonment of farming as a profession by many boys subsequent to their release from military service was not as vital a cause of the existent labor curtailment as are the high industrial wages and opportunities galore for indoor jobs which are prevalent throughout the country. He said that about 1,000,000 farm boys entered the military and naval services and that anyway 50 per cent of them returned to the farms after the hostilities had ceased. If they left the farms subsequently, it was only because the cities and towns afforded them better wages; their inherent desires were to remain in the rural sections.

Doctor Taylor predicts that if there is a shortage of food crops this year—and present balances are all weighed in that direction—the maximum scarcity will occur in the case of vegetables. He told me that truck farmers—and especially those in the Eastern States—because ordinarily they reside proximate to cities and central markets, have experienced the greatest difficulties of all soil-tillers in their efforts to secure adequate field assistance. This lamentable lack of labor combined with congested transportation facilities which impede the movement of truck crops from production sections to consumption points have united to complicate the vegetable producing and marketing enigma. During the present season two-thirds of the lower Rio Grande cabbage crop rotted in the fields because of inadequate transportation accommodations to convey the crop to the Northern markets.

On the basis of the last available census figures in 1910 there were 6,361,502 farms in the United States on which were employed 10,851,702 male workers. At that time the total land in farms amounted to 878,798,325 acres and of this aggregate, 478,451,750 acres consisted of improved land. These statistics indicate that one man worked 138.1 acres of land of which 75.2 acres were improved. The last estimate of the Bureau of Crop Estimates was that more than 6,717,000 farms were being operated while the supply of farm help had decreased materially. The indications are that each man or boy working on a farm this year will have to work anywhere from 85 to 90 acres of land to maintain anything like normal production.

During the war patriotic citizens over the entire country responded generously and in large numbers to the calls of the government requests for emergency labor to help harvest the food crops. In that instance the office men donned overalls and jumpers in order to produce food with which to defeat the Hun. This year they will have to duplicate their former exertions in order to provide food for their individual homes. Previously the "shock" troops served in order to defeat a vindictive and iniquitous enemy. This year they will work as dilligently in order to drive away threatening food famine and the emissaries of want.

The sentiments of Mr. Gray Silver, Washington representative of the American Farm Bureau Federation, are expressive of the concern which his organization attributes to the farm labor situation. "We consider that the best mediums which the American farmers can use to combat reduction in their labor supplies are the efficient utilization of the tractor and the plentiful application of commercial fertilizers," remarked Mr. Silver in the course of our conversation. "The acreage which is devoted to tilled crops must be cultivated as thoroughly as possible and effort should be exerted to produce high yields from the smaller areas which will be farmed this year. It is all right to increase grass seeding and pastures as well as to extend the area devoted to cover crops; but the farmer who intends to harvest these crops with live stock must take into consideration the present difficulties of financing such purchases due to the conservative attitudes of many of the banks. Similarly the contraction in credit is affecting the purchase of machinery and fertilizer.

"The Farm Bureau Federation is making particular appeal to the industries and manufacturing concerns to release as much labor as possible for emergency work on farms," continued Mr. Silver. "If the men who are unavailable for farm work but who remain in the towns and cities will work longer hours each day, their extra service will permit of diverting many of their farm-experienced mates to country labor. It really simmers down to the matter of whether or not—for example—a factory which employs 5,000 men would rather temporarily release about 1,000 of its men for farm work and ultimately have plenty of food in the markets or whether the plant would prefer to hold all its workers and abet greater inflations of living costs due to potential and drastic limitations in the food supplies."

In case of a food shortage the farmer will be the last one to go hungry as he will provide first of all for his personal needs. It will be the people in the towns and cities who will suffer. That is why it will be only judicious management on their part to respond as nobly as they did during the war period to the farmer's need for extra help. The farmer will pay wages in proportion to the prices which his crops will bring and the indications are that the prices will not decline for some time to come. The immediate need is to produce and harvest the maximum of crops. The marketing and distribution of these crops will logically take care of themselves under existent conditions. However, a fertile field for reducing living costs will be to improve distribution so that the spread between what the farmer receives and what the consumer pays for the foodstuffs will be more fairly adjusted.

Reports just received by the Bureau of Crop Estimates show that reductions of 5 per cent in the potato acreage and 29 per cent in the areas devoted to beans were already in evidence last year as examples of the curtailed production which resulted from the farm labor shortage. New York planted 97 per cent of the previous year's potato acreage; Michigan 90 per cent; Wisconsin 95 per cent; Minnesota 89 per cent; Colorado 94 per cent; Idaho 95 per cent and California 110 per cent. Aroostook County,

(*Continued on page 219*)

When we see the whole family thus on the job, we can understand why potato plantings were reported to be five per cent less in 1920 than in 1919. The ten-year-old boy, whatever he may achieve in individual cases, cannot make the same showing in the general average as a man

Practical and Inexpensive Farm Buildings from Willow Saplings

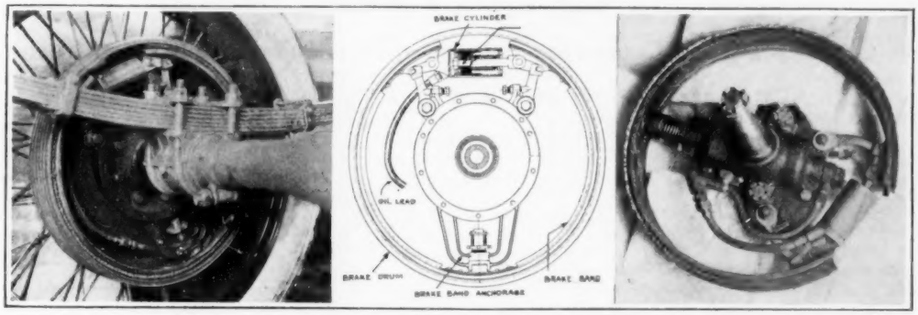
WILLOW saplings, because of their pliability and apparent versatility, have been put to a good many uses. From the oriental baskets and vases to the modern hot weather furniture, the willow sapling, or its close kinship, plays an important part.

But one is considerably surprised, if, upon traveling a country road, he suddenly meets up with a freak farmstead, especially if it happens to be in a modern farming region, which has, as the main form of building material, willow saplings. But such is the case. Up in the edge of the sandhills of Nebraska one may find just such a farmstead. Though primitive in style, and conflicting violently, at times, with certain conventional rules of carpentry, or to whatever class of building to which it is the closest related, the buildings found on the place do command the respect of the critic for their ingenuity alone. Each one, save the modest cottage home, is built of willow saplings. Double walled, with tightly packed insulation of straw and leaves, the barn, hog house, poultry house, and corn crib are as warm and storm proof as any modern frame building.

When the land was purchased by the present owner he found winter coming on and lacking surplus funds at the time, sought to solve the problems of housing his stock through the cold weather. Whether his ancestors were among those who wove baskets by the side of babbling brooks in

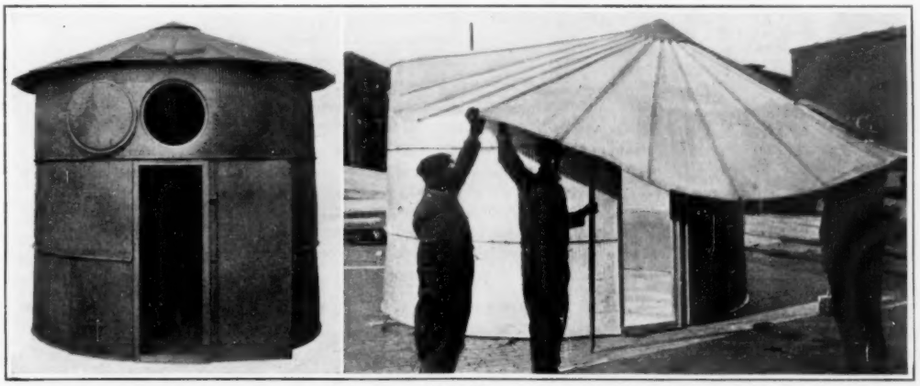
(*Continued on page 220*)

Two farm structures built of willow saplings, in architectural style just like the clothes hamper

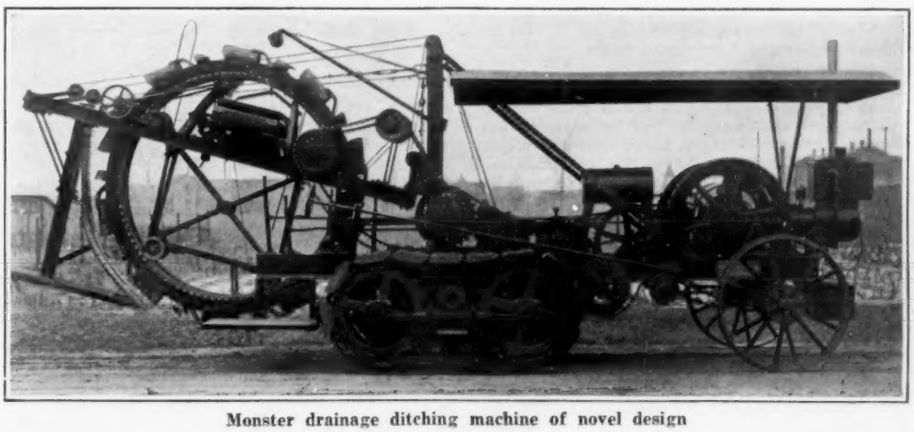


Left: The brake installed, showing the cylinder between the ends of the shoe. Since it is an internal-expanding brake, application of pressure in the cylinder applies the brake. *Center:* Diagram showing the scheme of operation. *Right:* The brake mechanism isolated from the wheel

The four-wheel brake that operates hydraulically



Steel tank for grain storage, and way in which the roof is assembled before putting it in place



Monster drainage ditching machine of novel design

The Four-Wheel Brake Again

AN automobile with brakes on all four wheels may be stopped in half the distance required if the brakes act on the rear wheels only. For this reason the four-wheel braking system is looked upon in many quarters as promising to be an important factor in the reduction of motor car accidents. Half a dozen European cars have four-wheel brakes and another half dozen makers have announced that they will use them on their new models. Recently a new fine car has appeared on the American market with brakes acting on all four wheels and controlled by a single pedal. This braking system is notable in that it is hydraulically operated.

The brake pedal is linked to a master plunger from whose cylinder flexible oil-leads run to the four brakes. The brakes are internal-expanding. A small cylinder with piston is placed between the ends of the brake shoe so that one end of the shoe is linked to the cylinder and the other end is attached to the plunger rod. When the pedal is depressed, the pressure is transmitted by means of heavy oil to the four brake cylinders and the brakes are applied. Ordinarily when the piston in the master cylinder has traversed one-third of its stroke the pressure is sufficient to lock the brakes.

There is a spring in each brake cylinder which automatically pulls the shoes away from the drums as soon as the foot is removed from the pedal. Hydraulic transmission of the braking effort eliminates the friction of the common types so that the new system requires no more foot pressure to apply all four brakes than to apply two brakes actuated in the ordinary way.

The hydraulic system has the advantage of extreme simplicity, perfect brake equalization, and little likelihood of getting out of order, although the last point may not be fully apparent at first glance.

Inasmuch as the front wheels must swing around their steering pivots as the car is guided the application of a suitable brake linkage is a matter of considerable difficulty, but a problem that is very nicely overcome by hydraulic means.

Separate leads run from the master cylinder to each rear wheel, the tubes following the triangular brace members which run from the front of the torque tube to the axle housing ends. A single tube runs to the front brakes, following along the left frame member to the spring and following the spring to the axle, where the lead branches, one going to the right brake and the other to the left brake.

(*Continued on page 220*)

Portable Grain Storage Tanks of Metal

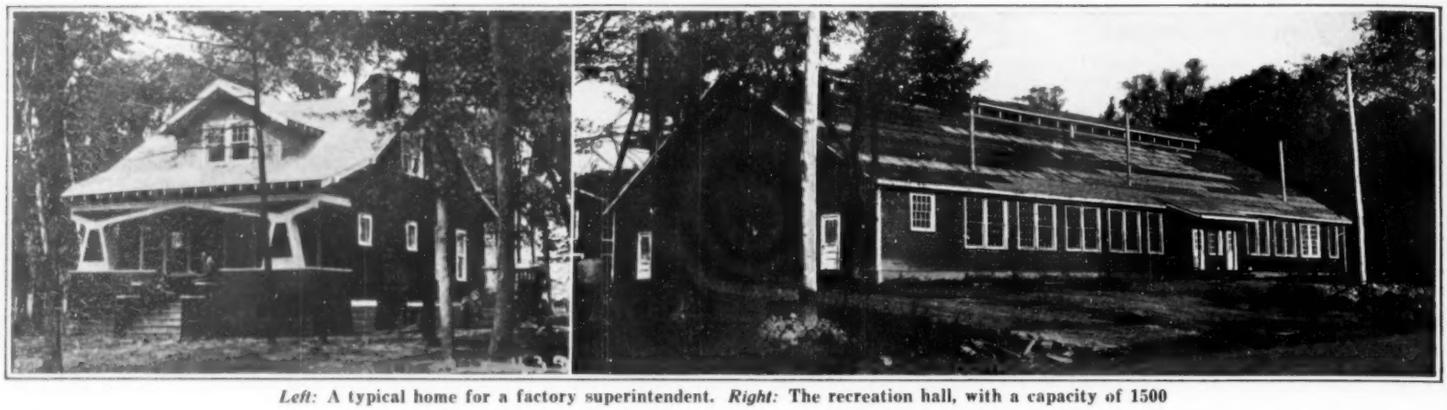
WE illustrate herewith a handy farm accessory manufactured by a large concern in Kansas City. It is designed to take the place of grain storage of less satisfactory sorts, its particular advantages being not merely the obviously fire- and damp-proof characteristics which it presents, but equally the ease with which the steel tanks can be put up and taken down and moved about, and the facilities which are offered for filling and discharging them. Manholes in roof and sides, and a large lip with a spout effect, fill the latter rôles. Ventilation is amply looked after. The tank is offered in various capacities, from 500 to 10,000 bushels.

A Ditch-Digging Giant

A WHEEL without spokes and hub, the mechanism consisting of two parallel iron rims held in fixed position by buckets riveted between the rims, is a brief description which suggests the novelty of a farm drainage ditching machine manufactured by an Ohio firm. Fifty of these machines are in use in one county in Ohio.

The rims of the open excavating wheel are supported upon four pairs of small wheels. Both wheels of the pair immediately above the point where the digging is accomplished are sprocket wheels, thus permitting the application of power. The buckets are open at the inner side, but close inside the rims is a metal plate covering one-half the circumference of the excavating wheel that retains the dirt in the buckets until it has been conveyed to the highest point. Here the upturned soil falls upon a belt conveyor which deposits the earth beside the freshly-cut trench.

(*Continued on page 220*)



Left: **A typical home for a factory superintendent.** *Right:* **The recreation hall, with a capacity of 1500**

Solving the Labor Problem—IV

Home Comforts and the Community Spirit as a Remedy for Heavy Labor Turn-Over

THE final success of that very remarkable motor, the Liberty engine, was due in no small measure to the introduction of molybdenum steel in its construction, notably for the crankshafts. This improvement was due chiefly to Mr. C. Harold Wills, whose valuable work in bringing the automobile to its present high stage of development is widely recognized and nowhere more so than among his brother engineers. So strongly impressed was Mr. Wills with the valuable qualities of the new steel, which had shown a marked superiority to the best alloy steels in toughness, workability and in strength per unit of weight, that he saw a long awaited opportunity to build a medium-weight, moderate-priced car, which should possess approximately the same power as the so-called high powered cars.

It is not our intention in the present article to speak of the car, but rather to describe the initial steps which were taken by Mr. Wills and his associates in framing their labor policy and building up an organization for the construction of the car.

The Problem of Labor Turn-Over

Like many another engineer of prominence, Mr. Wills has the advantage that to his wide technical knowledge is added an extended experience as a mechanic in the shops, with all that intimate knowledge of the thoughts, feelings and aspirations of the workman, and of the labor problem in general, which comes as the result of personal, day-by-day contact. He knew well that the greatest problem confronting the manufacturer was that of labor, especially in the automobile industry, where 85 per cent of the production costs is due to labor. He realized at the outset that the most fruitful source of economy would be found in securing and maintaining a labor force which was so well satisfied with its surroundings that labor turn-over would be reduced to a minimum. For a labor turn-over of 500 per cent in the course of a single year means that in a factory where, let us say, 5,000 men are employed, there will appear upon the payroll the names of no less than 25,000 men. In other words, while the daily force is maintained at an average of about 5,000 men, the constant migration of the men in search of conditions which they hope will be more to their liking, results in the passage of 25,000 men through the shops. It needs no argument to prove that high labor efficiency is impossible under such fluctuating conditions. The ideally perfect situation would be one in which there was no labor turn-over, that is to say, a factory in which the men that were working on January 1st were still on the job on December 31st.

American Workmen Demand Home Comforts

An analysis of the causes showed that this ceaseless coming and going of men, so far as the city of Detroit was concerned, was due to the shortage of houses and to the fact that the greed of the retailers in continually raising prices practically robbed the workmen of the liberal increases which were made from time to time in their pay. Undoubtedly, of these two conditions, the unbearable housing situation was the most disturbing. The self-respecting American workman does not like to go home after work and find his wife and children cooped up in a few rooms in a tenement house, with a minimum of light and air, and with no open spaces for recreation and no playground save the city streets for the children. He realizes that the claims of his family to more decent living conditions are well justified, and in many cases it is only a question of time when he throws up his job and goes elsewhere for the sake of his family. Mr. Wills decided that the true solution of the problem would lie in building a model town well out in the country but within touch of that great center of the motor car industry, Detroit. He selected a well-wooded site on the banks of the St. Claire River, where the ground is high and slopes gradually to the river. Here he purchased a tract of land comprising 4,200 acres and stretching for several miles along the banks of the St. Claire River.

IF labor is to be efficient in the shop it must be comfortable and contented in the home. This is a truth which has pushed its way to full recognition and is now appreciated as fundamental. Every industrial institution which has an enlightened labor policy gives attention in greater or less degree to the home life and recreation facilities of its employees. The present article shows how one company has given this matter the very first place in its broad policy of operation, building an up-to-date city for its employees before it erected its factory and put its plant in operation.—THE EDITOR.

Building a City of Contented Living

A town for the working force was built simultaneously, and indeed somewhat ahead of, the factory, and as a preliminary step a general survey was made of model industrial communities in this country and abroad, particular attention being paid to the housing facilities, the width of streets, park areas and similar features. The town of Marysville, as it is called, combines the best features of the English and other communities, with certain improvements suggested by the local conditions. The streets in the average English community were found to be 40 feet wide. The minimum for Marysville was set for 60 feet, and one-third of the whole area was devoted to playgrounds, parks and boulevards. It was decided that the smallest building lot for the working men should be 40 feet wide by 120 feet deep, so that every man could have his own front lawn and a rear garden.

The general plan was laid out with the idea of providing a separate house for each family and a series of community houses for the unmarried men. The workmen's houses are substantially built and are planned with a view to external artistic appearance and such internal arrangements as will lighten the duties of housekeeping. Each house is provided with a bath, electric lights, telephone if desired, and an electric cooking range, and the whole thing has been so well worked out that these individual homes have given great satisfaction to the tenants.

Since a large portion of the employees in the new shops are unmarried, it was necessary to provide for them a special type of accommodations, with home surroundings suited to their particular needs. A solution of the problem was found in the community or club house. These community houses, of which several have been built, each accommodate 56 men. Externally, they are of simple design and show a modified colonial architecture. They are built in groups around a large central dining hall which is capable of accommodating some 400 men. The underlying idea in the community house system is to provide a modified form of club life and encourage the social and fraternal spirit. The buildings are of two stories and they are planned on the general lines of the college dormitory. An excellent feature which is greatly appreciated by the men is the provision of a large lounge room on the ground floor. It is finished in oak, with an open fireplace flanked by library shelves at one end, and has a liberal supply of tables, couches and arm chairs, all of the furniture being leather upholstered and of high quality.

The Problem of Recreation

In planning this "City of Contented Living," as it has been aptly named, it was necessary to do more than provide living accommodations. Although your average automobile shop mechanic is painfully alive to the uncomfortable living conditions of such a congested city as Detroit, he is equally alive to the advantages of city life in the way of diversified recreation, and in order to round out and complete the attractiveness of the new community, it was necessary to make thorough provision for recreation. To this end, the company built a recreation hall capable of accommodating 1,500 people, which was ready for service when the city was thrown open for occupation, and Marysville has been placed on the cir-

(*Continued on page 220*)

Community houses for unmarried men, and the dining hall

New Aids for the Ice Harvesters

TWO of the latest developments in the ice harvesting industry are shown in the accompanying illustrations. The first view shows a huge wooden scoop which is pushed along by a powerful caterpillar tractor, for the purpose of removing the layer of snow from the ice to be harvested. It is said that this machine does the work of six men and six horses, and can clear the snow ahead of an entire ice-cutting force.

The second view shows a little power boat which is being used by a New York State ice-harvesting company for the double purpose of pushing the huge fourteen-ton cakes of ice along to the ice house, and keeping the ice channel from freezing. The boat is driven by a steam engine and propeller, and is so shaped that it works admirably as a pusher. It is reported that this boat takes the place of six men who ordinarily find it difficult work to keep the ice channel open during a cold night.

Copyright, Kadel & Herbert

Clearing the ice field of its layer of snow by means of the tractor-driven snow plow

Fighting New York's Snow Storms

SEVERAL weeks ago New York had its long-sought opportunity of trying out a brand new collection of snow-fighting equipment as well as a new plan of action. In less than twenty-four hours a heavy snow storm piled up 12½ inches of snow on the streets of the metropolis, causing no little inconvenience as might well be expected.

The present snow-cleaning equipment of New York came as the result of the blizzard during February, 1920, when traffic tie-ups due to the heavy snowfall cost the merchants of the metropolis something like sixty million dollars, and the city itself five and one-half millions for emergency snow-removal work. This experience caused the city officials to revise their former snow-fighting plans, and to purchase for the purpose one hundred small caterpillar tractors, fifty large caterpillar tractors, and 212 five-ton motor trucks, together with a varied collection of push plows and pull plows.

While the officials have not as yet had an opportunity of studying and reporting the results in detail, it appears that the new equipment and the new plan have worked out admirably. The five-ton trucks have been used with push plows for keeping the important arteries open during the snowfall, while the two types of caterpillar tractors in conjunction with push plows and pull plows have cleared the city streets in a minimum of time. The small tractors, weighing 4,000 pounds, have been used with push plows and pull plows, while the larger tractors of 8,000 pounds have been used with push plows.

The present plan of action in combating a New York snowstorm is to begin work while the snow is falling and keep at it so as not to give the snow an opportunity to pile up, if possible. To this end the motor trucks, fitted with push plows, are kept circulating through the main arteries of traffic, while the snow is falling. These vehicles are followed up by the slower moving tractors, which strive to keep the main thoroughfares clear of snow, and, in the case of the side streets, to clear a way through the center of the street. Meanwhile the snow accumulates in piles and ridges along the gutters, but does not interfere with traffic to any serious extent. The next step is to remove the piles and ridges and to enlarge the way through the side streets. This is carried out by means of motor trucks and men, in many instances, although the New Yorkers find that the tractors with push plows and pull plows can be used with good results for "sewering"—that operation in which snow is carried or pushed into certain sewers in order to dispose of it.

So anxious is the municipality of New York to handle its snowfalls in the most expeditious manner that it is investigating and testing all forms of snow-sweeping and snow-shoveling machines. Some excellent results have been obtained with some of these machines, and a further reduction in the number of men required to shovel snow is expected in the near future. One of the latest schemes to be tried out is the mounting of a high power water nozzle on the front of a small caterpillar tractor. Water at high pressure is supplied to the nozzle by a long line of hose trailing behind the tractor. The tractor charges the piles of snow, so to speak, and washes them away. Obviously, such operations can only be carried on in mild weather, but the results of preliminary tests are promising.

Copyright, Kadel & Herbert

This steam barge pushes the fourteen-ton ice cakes to the ice house and prevents the freezing of the ice channel

The Prehistoric Rock Paintings of Spain

THE cave paintings recently found in the eastern part of Spain are of extreme interest and certainly belong to the most surprising of all the discoveries made in the realm of primeval days. From these Spanish caves there have been obtained a number of paintings or carvings on rock, most notable among which are the large and extremely realistic pictures of animals, including the mammoth, the wild horse, the bison, the reindeer, the mountain goat, the cave lion, and some singular half-animal caricatures and certain still unexplained "symbolic" characters.

Certain of the Spanish prehistoric paintings are executed in light or dark red pigments. Since these are exposed to the more or less direct rays of the hot sun, they are usually a good deal faded or else obscured by an incrustation of dust. It is only necessary, however, to moisten them carefully with a sponge to see them in many cases revived in all their freshness. This application of the sponge does not injure the pictures, since the pigments, which were probably rubbed up originally with grease, have formed in the course of centuries a chemical union with the surface of the rock, so that they may be said to have actually become "fossilized." Doubtless, of course, time and the hand of man have either wholly or partially destroyed many others.

The peculiar interest that attaches to some of the Spanish prehistoric rock paintings is the fact that they contain numerous representations of the human form done in a most realistic manner. The "portraits" of human beings are usually full of life and motion, we learn from the March issue of the SCIENTIFIC AMERICAN MONTHLY, which carries a detailed article on this interesting subject. Female figures very seldom appear among them, and when they are seen they are clad in long bell-shaped skirts. The male figures are always naked, but usually carry weapons and wear certain ornaments, among which are very wonderful caps and "crowns" as well as armlets and knee bands, while attached to the shoulders or hips are fluttering ribbon-like decorative strips of material. Very conspicuous in these pictures are the bows and arrows with which hunters or warriors are armed.

Bridges and Civilization

BOTH from the technical and from the ethnographic viewpoint it is not without interest to study the primitive origin of bridge building, since this evidently presents a most difficult problem. Thus we learn from the March issue of SCIENTIFIC AMERICAN MONTHLY that the first bridges were undoubtedly the fallen trees lying across streams and the heavy vines

(Continued on page 220)

Left: **One of New York's large caterpillar tractors using a push plow on a side street.** ***Right:*** **Removing snow from New York shipping and trucking district by means of electric tractors and trailers**

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Glass for Ampuls

IN a recent number of the *Journal of the Franklin Institute*, Mr. J. E. Ewe reports tests employed in the selection of ampuls which are now used in very large quantities. Unselected glass may contain sufficient free alkali, or release it in the sterilization process, or while the filled ampuls are kept in stock, to precipitate a portion of the alkaloidal base, and unless due care is exercised in selecting the glass some may be used which will throw off splinters, especially under the stress of sterilization. The first defect would result in the lowering of the efficiency of the solution contained in the ampul, while the splinters of glass might result in discomfort, irritation, or even more serious results. Consequently, in addition to working with ease under the flame the glass must not produce turbidity in a 1 per cent solution of morphine sulfate or 2 per cent strychnine sulfate in normal salt solution when sterilized in the ampul. When a .6 per cent salt solution is sterilized in the ampul a careful examination of the liquid afterward, using a magnifying glass, must disclose no spicules or glass splinters. The glass must also be tested with respect to alkalinity. This is sometimes conducted by sealing water containing a few drops of phenolthalein test solution in an ampul and autoclaving it at 12 pounds steam pressure for 45 minutes. A pink color indicates alkalinity. There are a number of special tests for comparative purposes, and such data as lost water and vulnerability to alkaline fluids are also obtained.

Precautions in the Use of Caramel

CARAMEL is formed from sugar during cooking and may contain furfural. This material, which is volatile in steam, is slightly toxic—one-tenth of a gram causing headache in man, and five times that quantity killing a cat. Furfural is formed in the greatest amount at about 200° C. so that in candy making as low a temperature as possible should be used. Since the material is volatile in steam, no precautions are necessary in the preparation of materials like frosting, where the caramel is heated with water. It is desirable, however, to boil caramelized fruit syrups, using an equal volume of water for ten or fifteen minutes before serving them, and care should be taken to avoid formation of caramel in baking fruits. This work has been done by Plaisance and Monsch at the Iowa State College and Agricultural Experiment Station.

Use for Gallium

IN Scientific Paper No. 371 of the Bureau of Standards success is reported in devising a cadmium vapor lamp desired for securing a stable monochromatic red light source of high intensity. It was desired to use a lamp of the mercury vapor type, but neither pure cadmium nor a cadmium mercury alloy could be used owing to several practical difficulties. It has been found, however, that less than one per cent of gallium, which readily alloys with cadmium, so lowers the tensile strength of cadmium as to avoid lamp breakage and the vapor pressure of gallium is so low that its spectrum does not interfere with the brilliancy and purity of the cadmium spectrum. The lamps of this type that have been used are equipped with lead seals to avoid leaking about the electrodes and can be operated continuously with high intensity in the cadmium lines of the spectrum.

Separating Metal by Centrifuging

IN the *Philosophical Magazine* for March there occurs an interesting account of an attempt to determine whether common lead can be separated into isotopes by centrifuging in the liquid state. As is well known, there is an isotopic lead somewhat radioactive which differs from ordinary lead in a small degree in both atomic weight and density. Common lead is a mixture of these two. In the experiment, the lead was maintained liquid by an electric device and the centrifuge was run at a rate of 9,000 revolutions per minute. None of the six portions of lead removed showed any difference in density between the top and bottom and there was no evidence that the desired separation had been obtained. The authors have proceeded further and attempted to separate silver from lead as a substitute for cupellation, but this also was unsuccessful. In alloys of lead and tin, and lead, tin and bismuth there was an appreciable difference between the upper and lower layers of the centrifuged alloy. The authors believe if they could employ a centrifuge running with a higher peripheral velocity definite results could be obtained, particularly in separating a definite alloy like the tin-lead alloy.

A New Source of Alcohol

IN the Bulletin of the Imperial Institute a discussion occurs relative to the possibility of using the mowra flowers of India as a source of alcohol. The thick petals of these flowers are rich in sugar and are used by the natives as a food and more particularly for the fermentation of an alcoholic liquor called "daru" or mowra spirit. The tree produces 200 to 300 pounds of flowers per year and is cultivated for its valuable oil seed. The flowers have been used as a source of acetone, yielding ten times as much as that obtained by distilling wood. It is estimated that about 90 gallons of 95 per cent alcohol might be obtained per ton of dried flowers, and in one State in India there are said to be sufficient trees to produce 700,000 gallons of 95 per cent alcohol yearly. Already alcohol so produced has been used experimentally as a motor fuel in India.

Lignite Briqueting

ARRANGEMENTS have been made by the Bureau of Mines for coöperative work designed to make possible a favorable report which will stimulate the duplication of such a plant as it is intended to construct to demonstrate that lignite may be economically prepared as a fuel capable of storage.

The plant is to consist of a series of ovens which it is thought will coke a hundred tons of raw lignite per day. In this process the by-products will be recovered and from the carbon residue briquets are to be formed. The briqueting plant will be so located that the char will be passed directly from the ovens to the hoppers of the briqueting machines. A part of the money for this demonstration is supplied by the Government and twice that amount by individuals who have been active in an effort to utilize the vast deposits of lignites to be found in different parts of the country.

Hemlock Sole Leather

IN the March 25th issue of *American Leather*, the Tanners Council publication, is an interesting discussion on hemlock sole leather—a historical American production—which those interested in the subject will find interesting and informing. Among other things, the article indicates the influence which the ease of securing hemlock bark has had upon the location of tanneries in the past, regardless of climatic conditions, nearness of other raw materials, and transportation facilities.

Granulite

IN a late issue of the *Chemical and Metallurgical Engineering* a report of the American Chamber of Commerce in London is quoted to the effect that the discovery of a large deposit of granulite in Great Britain will put English glass manufacturers in a position to compete on a favorable basis in the world's neutral markets. This mineral contains not only silica, but potash and soda and gives good results in the manufacture of glass ware of the highest quality. The difference in cost of the new materials compared with that now in use is 15 shillings for the former and 2 pounds a ton for the latter. This mineral is suitable for pressed articles and window glass, glass enameled metal ware, and electrical insulators. The waste materials formerly used only for road building will produce dark colored glass.

Hard Rubber in Chemical Industry

BECAUSE it is non-corrosive and non-absorbent, hard rubber finds special application in industrial chemistry. From it pumps and fittings, pipes and utensils are made with sufficient flexibility and strength to perform the service. Through research it has been found possible to so vary the physical properties of hard rubber as to meet satisfactorily peculiar requirements, this being done by changes in the mixing of the batch, hot treatment, and curing methods. The quality of hard rubber depends upon the compounding and vulcanizing as well as the quality of the raw materials. Besides resisting acids and numerous other chemicals, hard rubber can be depended upon not to soften until nearly 212° F., but for the sake of safety chemical equipment is rarely used above 160° F. Being a molded material it appears in all sorts of shapes and sizes, including nearly a complete line of pipe fittings. The chemical pumps are rated from 6 to 65 gallons per minute capacity.

Chemical Industry in France

IN France, as in America, the importance given the chemical industries by the war is being shown by increased productive capacity. In 1913, sulfuric acid, which is one of the foundation stones of the chemical industry, was produced to the extent of 1,224,000 tons and this was 4,000,000 tons in 1919. Nitric acid advanced from 20,000 in 1913 to 360,000 tons, liquid chlorine from 300 tons to 90,000 tons, and calcium carbide from 32,000 to 200,000 tons in 1919.

Determination of Alcohol

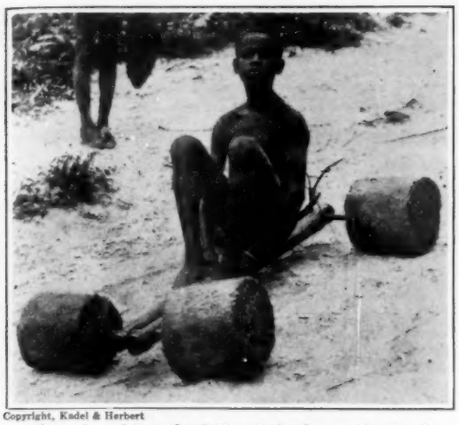
AT a meeting of the New York section of the American Chemical Society held recently a new device for determining the percentage of alcohol in beverages with a fair degree of accuracy was exhibited. The method depends upon an accurate determination of the boiling point or ebullition point, from which the apparatus derives its name, ebulliscope. The principle is not a new one, but the apparatus has been simplified for more universal use and as a test can be made in about 15 minutes the device is expected to be very useful since the margin necessary to keep within the law is a narrow one. The frequent use of this test enables the manufacturer easily to control his product as it goes through the plant. It is possible of course to prepare drinks from grain with less than the alcohol allowed by law, but usually when first prepared these beverages contain two or three per cent. This excess is removed by passing the fluid in thin sheets over hot surfaces or by heating the material in a vacuum, with the recovery of the excess alcohol.

Research in the Woolen Industry

A RESEARCH committee has recently been established by the National Association of Woolen Manufacturers for the purpose of considering in what particulars scientific research might be applied to the problems of wool manufacture at the present time. Having determined a few of the problems which appeared to be most pressing, it is probable that the committee will determine where the work can be undertaken to best advantage, under whose direction it is to be conducted, and prepare a budget for presentation to the Association. In Great Britain a research association has been established composed of various wool manufacturers. This is one of a series of such associations fostered by the Government Department of Scientific and Industrial Research. In the April bulletin of the Association, notation is made of a conference with the Director of the Bureau of Standards as to problems which might be undertaken on behalf of the manufacturers by the Bureau and it is understood that plans are being formulated for carrying on this work.

Dyeing and Printing

E. W. PIERCE, the author of an article on the development of dyeing and printing in the *Textile World Journal*, states that red, yellow and black were used in ornament and decoration between 2,000 and 5,000 years ago. Authentic records date back 2,000 years B. C., when calico printing was practiced in India and it is believed that printing preceded dyeing. The oldest dyeings are those found in the mummy cases of Egypt, running back to 1580 B. C. According to Pliny, madder, purple, safflower, woad, and kermes were used together with iron stains. The mordant was probably applied by means of blocks, stencils or brushes, after which the coloring matter was dyed in. According to the Egyptian records, red, brown, maroon, yellow and blue were available. At one time the Chinese produced a smoky gray colored cloth by a laborious process of treating the material with soot and glue and then pounding the fabric on a stone, after which it was washed and the process repeated until the desired shade was secured.



Copyright, Kadel & Herbert

Coasting down the hills of the Ivory Coast of East Africa

Coasting in Darkest Africa

BOYS are boys the world over. No better evidence of this fact could be found than the accompanying photograph, showing how boys on the Ivory Coast of East Africa enjoy coasting down steep hills on home-made coasters. In this instance a coaster consists of four pieces of wood and four cylinders of hardened clay serving as wheels. It is a safe bet, however, that the African lads get just as much enjoyment out of their crude coasters as the American lads do with their ball-bearing vehicles.

Turning Over the Eggs

THE stick-to-it-iveness of the broody hen is common knowledge, rocks and other impediments placed in the nest being little discouragement to her persistence. If permitted to sit on the eggs all day, the hatching qualities of the hen fruit may be marred. Anyway, eggs for hatching should be collected in freezing weather to avoid chilling.

Numerous commercial devices have been designed for keeping eggs when frequent turnovers are prescribed that artificial heat may penetrate all portions of the egg. The poultryman shown in this photograph has built a home-made device for turning the eggs when large numbers are being saved for hatching. The illustration adequately describes the mechanical details of the turning rack, where trays serve the purpose of exposing the eggs to the warmth of the room; otherwise the eggs would require shuffling with the hands. The turning rack is a convenient labor-saving equipment for handling the products of the hen in a room where the temperature varies from 50 to 60 degrees Fahrenheit. A more liberal temperature variation is permissible.

Both hen and incubator are impotent to hatch healthy chickens from weak germs, and hence the desirability of proper handling of eggs used for hatching purposes. If the collection is stored for only a couple of days a turnover is unnecessary. Daily use of the turning rack is recommended by the United States Department of Agriculture if the eggs are to be retained in storage for a week. If mechanical ingenuity is totally absent around the poultry yard—an almost improbable environment—then commercial egg cases can answer the purpose of the home-made turning device.

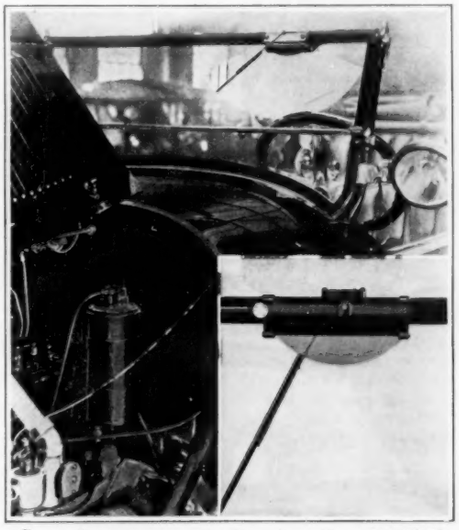
A home-made rack for egg-turning operations

Fitting Arms to the Electric Truck

AN ingenious apron attachment for the ordinary electric truck has eliminated the heretofore heavy labor involved in handling the usual 800-pound rolls of news-print paper. The truck fitted with the apron attachment picks up the heavy rolls, carries them off and even stands them on end. The roll-carrying mechanism consists of a heavy but perfectly balanced steel apron with a chisel member, shaped in such a manner that the roll is swept into the apron, so to speak, and held in place during transit, through the agency of a bar which slips over the heavy roll. The apron is attached to a heavy steel casting which revolves on ball bearings, said steel casting in turn being supported by a rocking structural steel frame. When the roll of paper is in place, the frame slips back at an angle, lifting the apron and its load about half a foot from the ground. To stand the roll on end the apron is revolved.

An Automatic Windshield Cleaner

A DEVICE for automatically cleaning windshields of rain, snow, and sleet from a space directly in front of the driver has been perfected by a Cleveland manufacturer. The suction of the motor furnishes the power for operating this device. The cleaner part of the device is clamped securely to the top of the windshield frame. A small flexible rubber tube runs from the cleaner through clamps which are clipped on the side of the windshield, on through the dash and connected to either the intake manifold or vacuum tank by means of special fittings. A convenient finger control stops and starts as well as regulates the speed of the cleaner.



General arrangement of automatic windshield cleaner and (in insert) close-up of cleaner itself

Artificial Pearls from Herring and Shad

ON account of the war many importations from Paris were cut off, and among them were artificial pearls. To make up for this loss many experiments were tried with more or less success. The crowning effort was achieved by one of the technologists of the Bureau of Fisheries, who was assigned to the task of finding in the United States a product from which artificial pearls could be manufactured. Before the World War French manufacturers of artificial pearls obtained fish scales from Russian fishermen and these were used in giving glass beads the pearl-like luster which converted them into "French pearls." The war stopped the Russian fishermen and no longer were French pearls received in the United States. American dealers called upon the Bureau of Fisheries to develop a substitute. It was found that the scales of sea herring and the shad in Chesapeake Bay possessed the delicate luster similar to Oriental pearls. Large quantities of these scales were procured and soon it was found that the silvery coating could be removed by a refining process which separated the coating from the pigment cells, mucous and other materials. From this coating "essence d'Orient" was easily manufactured, which was readily given the name of "pearl essence" by the Bureau of Fisheries. This substance contains the peculiar characteristic of adhering to any substance, so the manufacturers found that once the bead was manufactured a coating of pearl essence would harden like cement and give the "pearl" a marked resemblance to the genuine article.

Handling an 800-pound roll of news-print paper with a new type of electric truck

How Soot Accumulates in a Signal Lantern

NOT unlike the Scriptural lesson emphasizing the importance of the lamps being trimmed and burning when the bridegroom arrives, the signal lantern of the railway flagman should be in perfect order when the train proceeds on its journey. There are several contributory causes to the improper functioning of a lantern and its consequent dim glow, but poor signal oil is perhaps the chief offender. Hence periodical tests by the United States Bureau of Standards to determine the quality of oil being used in the railway service.

Reams of paper consumed in descriptive text in telling of the tests and their significance would be but a pitiful effort when compared with the glaring example illustrated in this photograph. After the lapse of one hour, under the surveillance of a scientist, this lantern showed signs of smoking; with the passing of three hours it was smoking badly, and leaving it to burn all night, what was discovered the next morning is told unmistakably by the picture. It was not burning when examined, the flame having been largely displaced by an accumulation of soot one and one-half inches in diameter and three inches long.

The testing of oil used in signal lanterns involves the duplication of the usage to which they are subjected in actual service. The lantern is lighted and after the lapse of one hour its candlepower is measured. Six hours having passed, the change in candlepower is again noted. The reading are supposed to reflect the relative quality of the various oils in use. Clearly, the fuel being used in the lantern shown in this photograph was of an extremely poor grade.

Accumulation of soot in a hand lantern

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

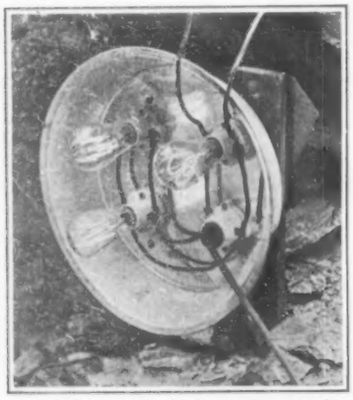
Turning the crank of this device marks the lady's skirt as shown

Making Milady's Skirt Hang True

TO lessen the time and labor involved in making milady's skirt so that it will hang true, and for all parties concerned, the skirt marker shown in the accompanying illustration was especially designed. The mechanism consists of a low platform one inch from the floor, upon which stands the lady. The skirt is then placed between the roller and marking wheel carried by an upright arm which is capable of revolving around the platform. When the operator revolves the crank at the top of the arm a motion is imparted to the roller and marking wheel below, at the same time the arm is pushed around according to the speed given to the marking wheel, thus forming, when so operated, a complete circle or mark around the bottom of the skirt. The average time consumed in making such mark is about forty seconds.

A Wash Pan Reflector

ONE of the best lighted construction camps on the Pacific Coast has harnessed a dish washing pan to serve as its artificial midnight sun. The dish pan is used in place of a regulation reflector to throw the beams of electric light to the farthermost recesses of the camp site. Permission was had of a power company whose service line passed close to the camping grounds, to plug in on its current for light service. Inventory of the camp equipment developed the fact that no reflector was available. Recourse to the dish pan as a satisfactory substitute was made. The emergency reflector has served the purpose so well that it has never been changed.



A simple wash basin and several porcelain receptacles make an ideal electric lighting unit

Buses May Replace Trolleys

RECENT trolley car strikes have served to demonstrate the efficiency of the motor bus as a common carrier of passengers to such an extent that prediction is freely made that these vehicles may eventually supplant the trolley car. During these strikes the motor vehicles used for the transportation of the public have given very good service and it is believed this form of service has now gained a foothold that will be permanent. Busses have been operated profitably over lines from which the street car service had to be suspended on account of operating at a loss. By filling the breach in the crisis the so-called jitney has won the support of the public and municipal authorities.

Street railway officials and even state transportation officials have smugly asserted that the "jitney" could never take the place of the street railway systems. Yet, as a matter of fact, motor vehicles are very rapidly taking the place of the trolley cars, and will continue to do so with increasing rapidity as the trolley by reason of their financial difficulties are obliged to increase fares and diminish service.

Shoes can now be placed in a metal rack on the back of a closet door

A Rack to Hang the Shoes

WHEN shoes are left on the closet floor they soon get kicked around and scuffed. The metal rack shown in the accompanying illustration fits any closet door and is so made that it will hold any sized shoe securely, notwithstanding the force with which the door may be shut. It does not fit the door at a right angle, but tips backward, holding the shoes securely in place.

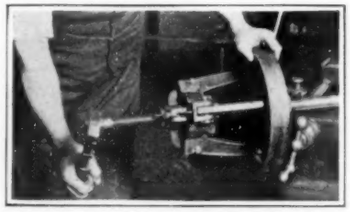
A Machine that Cleans Cement Bags

ONCE more a hand operation is threatened with extinction, due to the introduction of a machine to do the same work. This time it is the cleaning of cement bags, which is now being done by machinery.

Since there are from six to ten ounces of cement left in each sack after ordinary shaking, it is said that something like $1,000,000 worth of cement is lost each year from this cause alone. Not only is the cement lost that is left in the bags, but freight has to be paid on it in returning the bags to the mill. The story is told of one contractor who saved over 104 tons in building a single industrial plant, by cleaning his bags.

By hand, a few hundred bags are a day's work. With the machine shown in the accompanying illustration, 150 to 250 bags can be cleaned in an hour, depending upon the operator. And the improvement in working conditions over the disagreeable hand shaking makes it possible to secure more efficient help in addition to the labor saved.

The bag cleaner consists of a counter, exhaust fan, and dust arrester, cover and bag-baling attachment, driven by hand or power. No experience is necessary to operate the machine. The bag is dropped over the vibrators which are together when the machine is idle. A couple of turns of the hand crank and the bag is cleaned, ready to be taken off. The bags are counted and baled, as shown.



Tightening the screw shaft applies pressure to remove stubborn machinery parts

Removing the Stubborn Machinery Parts

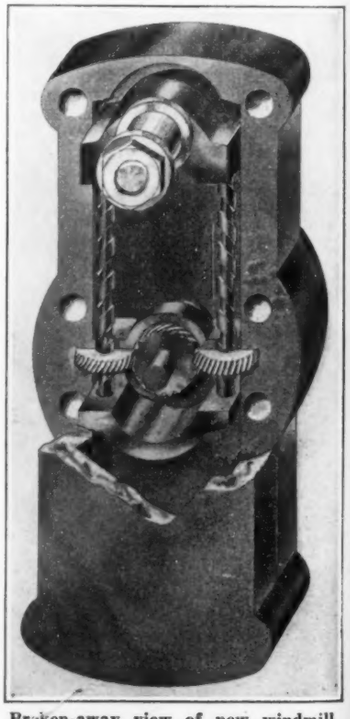
A NEW automatic puller facilitates the handling of motor and machinery parts in shop operations, such as textile mills, foundries, mines, garages, machine shops, motor factories, railways and electrical shops, where delicate but heavy parts must be handled carefully and yet where power in handling is necessary. The puller is equipped with a set of four arms or hooks, all easily removable so that the puller can be made quickly into a two-, three- or four-arm puller. A steel screw shaft passes through a center body of conical shape, the arms are fastened to the body in such a manner that when the screw is tightened the screw shaft applies pressure to the part from which another part is being removed, and at the same time forces the jaws to clamp tightly and to pull uniformly with great force. The removing of timing parts, magnetos, pump shaft gears and couplings is made relatively easy with such a puller.

Regulating the Stroke of the Windmill

THOUGH in late years the gasoline engine has to some extent at least supplemented the windmill on the farm for pumping water, a new invention gives promise of bringing the windmill back into favor, for after all wind power is the cheapest form of power we have at present.

The novel feature of this new invention, which has been worked out by A. B. Sabin of Node, Wyo., is that instead of furling the mill to adjust its power to the load, the load is adjusted to the power of the wind. This is accomplished by automatically varying the length of the stroke, so that the greater the wind pressure the longer the length of the stroke. The adjustment is brought about by placing in front of the power wind wheel a small wind wheel which works against a coil spring and turns a small shaft inside of the power shaft. This small shaft, by means of a worm gear and a coarse screw, draws the crank pin to or from the center of revolution of the crank arm through a slot in same. Because of the worm gear, it is a locked mechanism to all external forces acting upon the crank pin. The construction and design are simple and economical, with all the moving parts enclosed in an oil-tight case, which makes the maintenance practically nil. It would seem possible to incorporate this device into almost any direct stroke windmill, with little alteration of the present designs.

A few turns of the crank shakes a cement bag clean, ready to be returned to the mill



Broken-away view of new windmill mechanism for automatically regulating stroke

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to Correspondents are printed from time to time and will be mailed on request. Please write your queries; do not telephone them, please.

(14363) B. R. S. asks: What class of lever is an oar when a person uses it in rowing a boat? Does the person have a mechanical advantage of power or of speed, providing the blade of the oar stays where it is placed in the water? Same information if the oar does not remain where it is placed in the water. I believe that the same principle is used on the ordinary steam locomotive and considering one side, does the power exerted when the driving center of the driving wheels is below the axle give it the same amount of forward power as when the driving center is above the axle. A.—1. The class of lever to which the oar belongs is easily answered if you state what an oar is for, what work does it do. The answer is of course it moves a boat. The boat then is the weight to be moved, and the hole pin or rowlock is the point of application of the weight. The power is applied by the hand and the handle of the oar is the point of application of the power. There is nothing left for the water but to be the fulcrum, and a well-manned oar is practically at rest in the water, especially after the boat gets well under way. You must realize that the object of an oar is not to pull water around. The water cannot be the weight unless the object is to pull water around. The oar is a lever of the second class, power weight, fulcrim, weight in the middle. The power arm is longer than the weight arm and the mechanical advantage is in weight moved, the weight moved is greater than the power and moves slower than the power. 2. If the driving center of a locomotive wheel is below the center of the wheel, the power would act as a lever of the third class, fulcrum on the track, weight at the center of the wheel and power between the two. When the driving center is above the center of the wheel the lever is of the second class. Power weight, fulcrum on the track. This is decided by the fact that the object is to move the train, which acts at the center of the drivers. If the fulcrum does not hold, the wheel slips. The weight is the same, but the fulcrum gives way, just as an oar may in the water, and the rower may catch a crab, as it is called. If the driving center is below the center of the wheel, the gain is in speed; if above, the gain is in power.

(14364) J. R. E. asks: Would you be kind enough to please furnish me, if possible, with the formula for making the tint or liquid with which electric light bulbs are colored. If possible, I would like to know how to prepare the different colors. A.—The dips used for coloring the bulbs of electric lamps are simply thin quick-drying varnishes colored with aniline dyes of the desired hue, red, blue, green or other color. A varnish thinned with alcohol would dry quicker than if thinned with turpentine. Some of the commercial lacquers on the market can be used, but we cannot, of course, mention the names of the commercial article in these columns.

(14365) C. A. P. asks: In writing deeds or descriptions of lands, in which certain reservations are mentioned, is the quotation, "of which 0.35 of an acre are to be reserved" correct in reference to the verb "are"? I contend that the verb "is" should be used instead of "are." Should not the fraction "0.35" in this connection, whether written 0.35, .35, 35/100, or 35 hundredths, be followed by "is" instead of "are"? A.—Whether "is" or "are" should be used in the case proposed, depends upon the facts of the case. If the .35 of an acre is one lot of that area and is thought of as a whole, then "is reserved" is the proper verb; but if you have small lots of one-hundredth acre each and 35 of these in your mind then "*are* reserved" is the proper form to be used. Probably our first statement meets the case since the lot would be too small to be of value. But if the lots were larger a case might be made out where *are* reserved would be used. It does not matter how the fraction is written in deciding the point at issue. It depends solely upon the viewpoint of the writer. If he has in mind a unit of which he has 35 then a plural verb is required, otherwise a singular verb should be used.

NEW BOOKS, ETC.

CALIFORNIA HIGHWAYS. By Ben Blow. San Francisco: Manager, Good Roads Bureau, California State Automobile Association, 1920. 8vo.; 308 pp.; illustrated.

Neither a technical work nor a tourists' guide, "California Highways" is simply the story of the development of state and county highway systems, told in response to public demand. Organization, financing, types of construction, and labor and maintenance are set out in as popular a way as is consistent with accuracy, the larger projects are separately taken up, and campaigns and county activities are historically treated. There are 30 good maps and many splendid plates.

STRATEGIC CAMOUFLAGE. By Solomon J. Solomon, R.A. New York: E. P. Dutton and Company, 1920. 4to.; 62 pp.; illustrated.

This is an arresting, one might say unique, work. German methods dominate the exposition, and not until the war ended were the magnitude and perfection of these methods recognized. To pick one sentence from Ludendorff's "War Memories," "This concentration of 40 or 50 divisions had not been observed by the enemy." How such secret movements were accomplished the text, photographs and colored drawings of this book clearly demonstrate. Relative tone values are studied, tricks such as sham tram lines on hangar roofs exposed, and we see that camouflage is indeed "an art to be taken seriously," a tremendously important arm of defense still in its infancy.

LETTERING WITH PEN AND BRUSH. (By Wm. Hugh Gordon. Cincinnati: The Signs of the Times Publishing Co., 1920. 50 8vo. cards.

The Gordon System is a departure from the usual bound text-book, presenting its lessons on large, separate cards. Each card contains two lessons, and the convenience of being able to place a particular lesson upright before the worker, as a copy, will at once appeal to students. The familiar music staff is used as an aid to alinement and construction, and card writing and commercial art work are exemplified.

BY-PATHS IN CURIO COLLECTING. By Arthur Hayden. New York: Frederick A. Stokes Company, 1920. 8vo.; 462 pp.; illustrated.

Collecting, an absorbing by-path of human activity, has itself by paths that Mr. Hayden has charmingly described. To preserve the historical and permanently beautiful from oblivion is not an ignoble aim; the author rescues for us old fans, playing cards, silhouettes, chests, and teapots, and—more sinister souvenirs!—mantraps and spring guns, and ancient woodcuts such as those of the Dance of Death. Fine illustrations double the value of the work.

PHOTO-ENGRAVING PRIMER. By Stephen H. Horgan. Boston: American Photographic Publishing Co., 1920. 8vo.; 81 pp.

Apprentice engravers and others will find in this book an authoritative response to a genuine demand for concise instruction in this subject. The studio and its equipment, the darkroom, chemicals, recipes, and approved methods, are so put before the reader that he is enabled to produce creditable work either in line or half-tone.

PRICES AND PRICE CONTROL IN GREAT BRITAIN AND THE UNITED STATES DURING THE WORLD WAR. By Simon Litman, New York: Oxford University Press, 1920. 8vo.; 331 pp.; graphs.

This is No. 19 of the Preliminary Economic Studies of the War, edited by Prof. David Kinley. The presentation of the subject is thorough; the conclusions point to the fact that for relief from profiteering and manipulation we must look to psychological rather than legal influence. Foodstuffs, fuel, metals and textiles are separately and informingly discussed, and our Government's war policy is in the main upheld.

AMERICA'S GREATEST DAM. By William Benjamin West, B.S. Boston: W. B. West, Massachusetts Institute of Technology, 1920. 8vo.; 64 pp.; illustrated.

This attractive album comprises a fine gallery of photographs of Muscle Shoals, the great dam, and the outstanding features of Nitrate Plant No. 2, with sufficient textual matter to make clear to the technologist and general reader the immensity of the undertaking and the ways in which problems were surmounted.

ALL ABOUT TANK CARS. New York and Philadelphia: Standard Tank Car Company, 1919. 8vo.; 657 pp.; illustrated.

In this unique work attention is centered upon a mode of transportation that did yeoman's service during the war and is steadily growing in favor. There are specifications and drawings of trucks, tanks and cars for all purposes, and the Code of Rules is given, with a full index. The book abounds in useful tables, foremost among them being "Copyrighted Distances," compiled with especial care and not to be found elsewhere, and showing mileage allowance prior to and after the Commission's ruling of October, 1918. This permits ready-reckoning of the mileage earned by cars of all the important roads. The dependence of our merchant marine on the tank car should alone give this work a prominent place in railroad literature.

COCOA AND CHOCOLATE. By Arthur W. Knapp, B.Sc. London: Chapman and Hall, Ltd., 1920. 8vo.; 210 pp.; illustrated.

Cocoa culture is gradually assuming the aspect of a science, and world production has risen from 194,000 tons in 1908 to 431,000 in 1919. The author has given us an accurate, readable account covering the history of the product from plantation to consumer, with recent developments interestingly sketched. Cultivation, harvesting and preparation for market, manufacture of cocoa and chocolate, by-products, composition and food value, all are briefly but adequately dealt with, and both in text and illustrations British manufacturers have coöperated to make the book authentic and comprehensive.

TIN, SHEET-IRON AND COPPER-PLATE WORKER. By Leroy J. Blinn. New York: Henry Carey Baird and Co., 1920. 12 mo.; 334 pp.; illustrated.

An old workshop companion here appears in a new, thoroughly revised edition, with improvements and additions that bring it up to date. In pattern cutting, the modern system of triangulation is emphasized. Metallic alloys and solders are dealt with very systematically and the best modern practice is incorporated. The recipes and tables have been passed upon by experts, and the sheet metal worker may turn its pages in confident expectation of finding much that will benefit him from day to day.

TANKS IN THE GREAT WAR. 1914-1918. By Brevet-Colonel J. F. C. Fuller, D.S.O. New York: E. P. Dutton and Company, 1920. 8vo.; 331 pp.; plates, diagrams and maps.

The brotherhood of the Tank Corps, rallying about their Chief G.S.O., have helped him to write the inside history of their revolutionary engine of war. Colonel Fuller is not only an enthusiast on tanks; he is a keen observer and thinker—and a writer. His work is healthily sensational without losing caste as a record of facts. He explains how the tank, a descendant of the old war cart of 1456 and of the modern tractor, came into being, its mechanical characteristics, and its employment and achievements in the war. It is a book on no account to be missed.

T. N. B. AND T. N. T. (Trinitrobenzene and Trinitrotoluene.) By Captain M. Kostevitch, Russian Guards Artillery. 8vo.; 38 pp.; illustrated.

This brochure contains the gist of Captain Kostevitch's investigations and conclusions as carried out in a Petrograd laboratory shortly before the war began. His laboratory nitration system is the subject of a folding diagram, and the application of his method of vapor pressures to the study of mixed acids is a feature of the work. There are other diagrams of molecular percentages, and a series of microphotographic plates show trinitrotoluene as derived from various substances.

SHOP PRACTICE FOR HOME MECHANICS. By Raymond Francis Yates. New York: The Norman W. Henley Publishing Company, 1920. 8vo.; 320 pp.; 309 engravings.

At fourteen the author began to "make things"; he looked in vain for a book that really helped the amateur to surmount his little difficulties in an inexpensive, easy way. Since then he has solved for an army of amateurs their everyday problems of how and why; here his excellent instruction takes the form of a progressive text in mechanics, telling of the use of tools, pattern-making, shop practice, and the construction of small machines. His ingenious devices and suggestions will gladden the heart of the home worker.

PETROLEUM REGISTER. 1919. New York: Oil Trade Journal Inc. 4to.; 652 pp.

The industry will find this annual directory greatly enlarged, improved, and of increased usefulness. It lists the producers, refiners, marketers, geologists, and manufacturers and dealers in equipment, of the United States, Canada, and Mexico. The statistical section has comprehensive figures on production, consumption and exports, price records, and other data of importance. Supplementary pages, issued bi-monthly, furnish changes and additions of timely value.

PERSONAL IDENTIFICATION. By Harris Hawthorne Wilder, Ph.D. and Bert Wentworth. Boston: Richard G. Badger. 8vo.; 374 pp.; illustrated.

A professor of zoölogy and a former police commissioner have joined forces to bring before the general public an important problem touching civilized life at many points. Insurance companies, banks, and business men are seeing the advantages of some mode of personal identification, and all known methods are described in this comprehensive work. From the Bertillon system to poroscopy, procedure is made plain, and of course a great deal of science is devoted to finger, palm and sole impressions, and their classification, and friction-ridge identification and its possibilities are set forth. Many authorities contribute information and photographs.

SUCCESS FUNDAMENTALS. By Orison Swett Marden. New York: Thomas Y. Crowell Company, 1920. 8vo.; 307 pp.; frontispiece.

One of our foremost lay-preachers on the text Success comes forward with an unsermonlike sermon on foundation principles. He has pregnant words on health and efficiency, a chapter on how to find yourself, and others on confidence, the law of opulence, and salesmanship. The book radiates the same infective enthusiasm as its forerunners—an enthusiasm that accomplishes, because it never loses touch with the realities.

THE NATURE OF ANIMAL LIGHT. By E. Newton Harvey, Ph.D. Philadelphia and London: J. B. Lippincott Company, 1920. 8vo.; 182 pp.; illustrated.

Considerable mystery still attaches to bioluminescence. Touching but slightly upon its evolutionary phase and the structure and uses of luminous organs, and attempting no decision as to whether or not the phenomenon is due to the vibration of electrons, Prof. Harvey confines his investigations chiefly to the physical characteristics of animal light and the chemical processes underlying its production. We know that some material is oxydized. The book tells what progress has been made toward identifying this material and explaining why light accompanies its oxidation.

PRACTICAL ELECTRICITY. By Terrell Croft. New York: McGraw-Hill Book Company, 1917. 8vo.; 646 pp.; illustrated.

Without resort to the higher mathematics, "Practical Electricity" gives basic facts and theories and up-to-date applications, imparting a true working knowledge. The work also constitutes a good review text for the university graduate. The electron theory is freely used as an aid to exposition, the analogies are drawn from familiar things, and the excellent illustrations are almost self-explanatory. A comparison of this with other works of similar character cannot but result in a growing sense of its distinction.

CASTING TACKLE AND METHODS. By O. W. Smith. Cincinnati: Stewart and Kidd Company, 1920. 8vo.; 257 pp.; 14 plates.

Lovers of the much-loved sport of angling will meet in the author of "Casting Tackle" a kindred mind. They will revel in the simple ingenuity of take-a-parts, lures, and tackle boxes; but the volume also strikes a higher note; it leads the reader into pleasant pastures, beside, into, and on flowing waters, incidentally revealing the fascinating methods that make the happy and successful angler.

ELECTRICITY SIMPLIFIED. By T. O'Conor Sloane. New York: The Norman W. Henley Publishing Company, 1920. 12mo.; 218 pp.; illustrated.

For some years this work has lent a strong, guiding hand to the beginner; the new edition incorporates the numerous important changes in special branches of electricity—wireless communication, X-ray practice, and incandescent lighting, for examples; it combines the merits of a brief treatment with as much simplicity and thoroughness as length allows, using mechanical analogies freely, and taking the great pains to give the student a solid foundation of essential theory and practice.

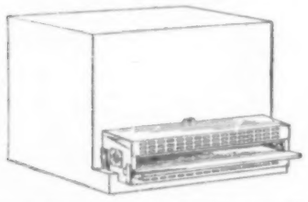
Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of Interest to Farmers

TRACTOR FOR MOTOR PLOWS.—J. N. PARKER, c/o Parker Motor Plow Co., Richmond, Va. This invention has among its principal objects to improve the operation and reduce the cost of construction of traction mechanism, to promote the manual control of the plow and traction mechanism thereof, to vary the traction speed, and to simplify the construction of the details. The invention relates more particularly to the construction and arrangement of parts composing the motor plow.

BEEHIVE.—D. S. ROWE, Marseilles, Ill. The invention relates more particularly to an automatic bee trap. The primary object is to provide means whereby the entrance and exit openings of a beehive may be automatically closed by the weight of the occupants to prevent the bees from leaving the hive in



A PERSPECTIVE VIEW OF A HIVE, WITH INVENTION ATTACHED

large numbers, which is commonly known as "swarming." It is a further object to provide a means by which the ordinary passage of the bees in their performance of gathering honey is unobstructed.

COTTON PLANTER.—H. B. BARFIELD, Fort Necessity, La. This invention has for its object to provide a planter of the character specified by means of which cotton seed may be planted at different depths, to insure a fair stand of growing plants regardless of weather conditions which might hinder the sprouting of deep or shallow planted seed.

Of General Interest

AWNING AND SCREEN.—F. G. DARE, 418 Stuyvesant Ave., Brooklyn, N. Y. The invention relates to a combination awning and screen, and has for an object to provide a construction wherein the full benefit of the screen is secured and at the same time an awning is properly held in position in respect to the screen. A further object is to provide a screen and awning formed to be readily collapsible when the screen is to be stored.

METHOD OF SURFACING.—J. HAMIL, 509 E. 77th St., New York, N. Y. More particularly the invention relates to surfacing over the conventional "scratch" used on ordinary "stucco" walls; for this purpose an ordinary stucco mixture is provided, but with any desirable number of vari-colored foreign fragments, such as glass, are incorporated in the mixture, which when in a semi-plastic state, is gone over with the edge of a trowel which serves to turn the fragments to the surface.

CULVERT.—M. R. DEYO, East Peoria, Ill. This invention has for its object to provide a culvert composed of hollow tiles formed from plastic material capable of hardening and suitably reinforced, the tiles being placed end to end and having means in connection therewith for permanently locking them together and to the head walls, and wherein a continuous compound reinforcement is provided.

ROLLING CRUTCH.—M. D. SCOTT, 214 N. Tremont St., Kewanee, Ill. The object of the invention is to provide a device especially adapted for use by invalids who lack confidence in their ability to walk, after illness, injury and the like, wherein the crutch is so arranged that it will afford a firm, secure support to the user without any possibility of falling, and which may be rolled along the ground as the user walks.

COMPOUND FOR TEMPERING IRON AND STEEL.—B. V. ALDRICH, Vandalia, Mich. The foremost object of the invention is to provide a compound of a few simple ingredients which, when applied to the metal in a cherry-red heated state, will effectively temper or harden it. The compound comprises sal soda 6 parts, sulphur 4 parts, b[illegible] antimony 1 part and rosin 1 part, all separately pulverized and compounded in the proportions stated.

MAYONNAISE MIXER.—J. W. DAILEY, Box 1361, Walkerscille, Mont. The invention relates to beaters for making mayonnaise dressing. One of the principal objects is to provide means whereby the olive oil may be fed in the desired quantity, drop by drop, to the dressing while it is being whipped. A further object is to provide a device which is extremely simple, durable, efficient in operation and inexpensive to manufacture.

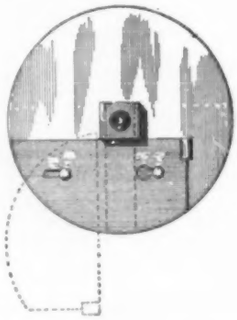
DRIP RECEPTACLE FOR REFRIGERATORS.—C. W. FISH, 25 Perkins St., Winthrop, Mass. It is the purpose of this invention to eliminate the use of the drip pan beneath the refrigerator, or a connecting waste pipe to the sewage system, the object being to provide a receptacle which is completely encased within the refrigerator so that the cooling properties of the ice dripping are utilized to further cool the food chamber, and to arrange the receptacle conveniently to permit its ready removal for emptying without stooping as in the old style pan.

HOSE COUPLING.—H. J. FITZPATRICK, 153 Nellie B Ave., Athens, Ga. Among the objects of the invention is to provide a coupling which can be quickly operated to couple or uncouple and which when in coupled position will form a tight juncture of the parts. A further object is to provide a coupling which dispenses with any turning movement of the members relative to each other to couple them together and which is operated by means of a longitudinal movement of the parts.

SCREEN FRAME.—M. J. and A. ROTH, Grand Ave. and McIntosh St., East Elmhurst, N. Y. The invention relates particularly to an adjustable screen frame for windows. The principal object is to provide an adjustable structure which is adjustable both in its width and height, with means which render the application of the screen fabric thereto an extremely simple and expeditious task. The device provides a strong and durable structure, proof against the entrance of insects.

COMBINATIONAL ROOF LADDER AND BRACKET.—H. GRUSH, 21 Jacoby St., Johnstown, Pa. The purpose of this invention is to provide a device which with little or no modification can be used upon the roofs of buildings either as a roof ladder or as a bracket, thus enabling carpenters and other workmen, while at work upon a building, to save time and space.

RAT SHIELD.—A. G. GIRARD, 2825 Laguna St., San Francisco, Cal. This invention relates to rat shields for ship hawsers, the primary object being to provide a cheap and practical



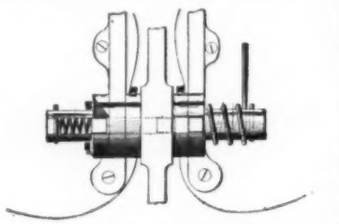
A SIDE ELEVATION OF THE DEVICE

device which may be conveniently applied to the hawser in the form of a disk, a section of which is hinged to drop away and admit the hawser to prevent rats from boarding the ship when it is docked at wharves or the like.

CALENDAR.—J. E. MELTON, Bismarck, N. D. An object of the invention is to provide a calendar having a removable calendar pad, each page of the pad having ruled and numbered spaces on the back for writing memoranda, the pad having combined rings for holding the pages together, and a brace for stiffening the otherwise flexible pad, a pocket also being provided for temporarily preserving small articles and various data.

DEVICE FOR HOLDING SOFT COLLARS.—F. J. ANTELOTTI, 136 Granby St., Norfolk, Va. The object of the invention is to provide a device capable of being attached to soft collars or removed therefrom, and of sufficient rigidity to hold the collar erect under all conditions and also one wherein the device may be adjusted to permit use with collars of various heights.

THEATER CHAIR.—O. F. WASMANSDORFF, Lewistown, Montana. This invention has for its object to provide mechanism in connection with the under portion of the chairs to prevent preemption of the end seats; each seat is



SHOWING A PORTION OF THE MAIN STANDARD OF A PAIR OF ADJACENT SEATS

locked in inoperative position until the master seat is occupied, when the adjacent seat is unlocked and so on through the remainder of the row, when the master seats which may be the two center ones are occupied the remainder will be filled toward the entrance aisles, thus preventing the squeezing past those already seated.

LAWN SWING.—G. H. BUGENHAGEN, New Jacobson Bldg., Minton, N. D. Among the objects of the invention is to provide a swing which is rigidly supported, and which is provided with seats for one or more occupants, each of which may assist in propelling the swing, the propulsion of the swing being effected by means of the hands and feet. The device is simple in construction and not liable to get out of order.

CHECK PROTECTOR.—J. W. PRICE, 1908 E. 6th St., Tulsa, Okla. This invention has for its special object to provide means for defacing a check or the like in such manner that erasures cannot be made without showing plainly that the check has been tampered with. Other objects are to provide in combination with this device a small wrench, a bottle cap remover, a screw driver, envelope opener and a spike for lifting corks or for manicuring.

BATHTUB.—J. N. MUSKIN and R. B. CRUMP, address R. B. Crump, 1110 Broad St., Newark, N. J. The invention has particular reference to attachments for bathtubs so designed as to enable a bathtub to be partitioned off and use not only in the ordinary manner, but also as a combination tub with independent compartments. The partition includes a seat structure hinged to the upper edge, this structure being adapted to be used in a reversed position as a basin support.

FOOD PRODUCT.—MARIE BLOCH, 377 Richmond Turnpike, Stapleton, Staten Island, N. Y. An object of this invention is to provide a palatable and nutritious food product consisting of tomatoes and eggs mixed together to produce a liquid material, flour added to this and thoroughly worked and kneaded to produce a paste or dough of thin strips, and finally cut into pieces of suitable size to be uniformly dried.

WOOD COMPOSITION.—G. MAGNANI, c/o O. D. Parker, 19 Park Place, New York, N. Y. The chief object of the invention is to provide a wood composition which will be strong and durable, and which will have a highly polished surface, so that it may be especially adapted for use in the manufacture of picture frames or other ornamental devices where a highly finished surface is desirable. The composition consists of wood pulp, starch, rosin, wheat flour, boiled linseed onl, and water.

PASS BOOK AND THE LIKE.—L. P JOHNSON, 523 So. 8th St., Salt Lake City, Utah. The invention relates to bank pass books and the like and more particularly to blank books in which entries are made from time to time, the object being the provision of page holding and marking means in connection therewith by means of which the proper and current page for entry will be indicated and apparent at all times.

ATTACHMENT FOR HOSE.—J. A. FULTON, Astoria, Ore. An object of the invention is to provide an attachment for garden hose which takes the place of an ordinary nozzle and which permits a spray or stream of any kind to be directed from the hose and which forms a brace for a short length of the hose to permit the ready manipulation thereof.

FOG LIGHT.—R. C. GRADY, c/o U. S. S. "Florida," c/o Postmaster, N. Y. This invention has for its object to provide a light primarily designed for marine use, and when the visibility is low, as for instance during a fog or when the navigational lights cannot be seen, wherein the light is so arranged that a powerful ray may be sent downwardly through the water at a slight angle, to be reflected from the bottom, to cause the rays to be visible at the sides of the ship when the water is shallow.

FLY ESCAPE.—C. LER. CASSADY, c/o Strand Theater, Marion, Ky. The object of this invention is to provide an escape adapted to be used in connection with screens, for permitting flies to escape at the top of the screen, wherein the escape is formed from sheet metal cut and bent to shape, and capable of being easily attached to the screen frame at the top thereof.

CRAP DICE FRAME.—W. N. COBB, c/o R. Blackinton & Co., North Attleborough, Mass. Among the objects of the invention is to provide a frame adapted to hold a pair of dice together and which is provided with means for attaching the device to a watchchain or the like whereby the dice so held will be displayed. A further object is to provide dice with precious stones embedded therein, and, although ornamental in appearance, are thoroughly practical commercially.

Hardware and Tools

TOOTH FOR SHOVEL DIPPERS.—C. H. MULRONEY, 7314 Howard Ave., Cleveland, Ohio. The invention has for its object to provide a tooth for shovel dippers having a base with a detachable wearing plate at its bottom and a detachable point at the front of the tooth. The point has a rearward projection fitting a cavity or recess in the base, and the base has a forward projection fitting a cavity or recess in the point. There being an opening in the base so that a bolt may be disposed to secure the foot of the point to the base.

SKIN MARKER.—O. H. FOSS, Box 335, Maddock, N. D. An object of this invention is to provide a portable skin marker which when moved over a skin will operate to cut or sever the skin, and at the same time provide a series of transverse cuts at both edges of the severed portion which may be of a depth and spaced apart a uniform distance so as to identify the goods. The device may be easily manipulated and will most efficiently perform the work. The same invention has been granted a second patent for skin marking; the object of this being to provide a device for puncturing a skin, and clenching an eyelet marker in the skin, the device can be quickly operated and is strong and durable in use.

SHADE ROLLER.—D. E. SCHIMMEL, 194 Hooper St., Brooklyn, N. Y. An object of the invention is to provide a shade roller having a minimum number of parts and arranged to operate smoothly. A still further object is to provide a pawl and ratchet mechanism in which means are provided which co-act with the spring and roller for positively gripping when the roller is being unwound and for easily releasing when the spring is rewinding the shade.

DIGGER.—W. LAMBERT, Grandview, Wash. The invention pertains more particularly to devices of this character especially adapted for digging holes for fence posts, trees, plants, etc. The device comprises a pair of blades pivotally carried by a casting, a handle and a sleeve slidably mounted thereon to open the jaws of the digger and dump the dirt therein contained.

DOOR LOCK.—I. HAMMER, 811 East 165th St., Bronx, N. Y., c/o Goldenberg Bros. & Co. This invention has reference more particularly to a combined permutation and key operated door lock. The primary object is to provide a lock which may be operated by either a key or a combination so that in the event that the key is not accessible any one

(*Continued on page 218*)

LEGAL NOTICES

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents, etc.**

SCIENTIFIC AMERICAN

Contains Patent Office Notes, Decisions of interest to inventors—and particulars of recently patented inventions.

MUNN & CO., SOLICITORS OF PATENTS

Woolworth Building, NEW YORK
Tower Building, CHICAGO, ILL.
Scientific American Building, WASHINGTON, D. C
Hobart Building, SAN FRANCISCO, CAL

Annual Subscription Rates
Scientific American Publications

Scientific American (established 1845) one year $6.00
Scientific American Monthly (established 1876) one year $7.00
Postage prepaid in United States and possessions, Mexico, Cuba and Panama.

Foreign Postage

Scientific American $1.50 per year additional.
Scientific American Monthly 72c per year additional.

Canadian Postage

Scientific American 75c per year additional.
Scientific American Monthly 36c per year additional.
The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check.

Classified Advertisements

Advertising in this column is $1.00 a line. No less than five nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

BUSINESS OPPORTUNITY

SUBSTANTIAL manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $2000 necessary. Will allow expenses to Baltimore as explained. Address, Mr. Clemmer, 603 N. Eutaw St., Baltimore, Md.

FOR SALE

AUTOMOBILE TIRE FILLER. Entirely different and far superior to anything on market. Discovery expert chemist. Formula, directions, license to manufacture and sell five dollars. Profitable business for you. W. Stedman Richards, Consulting and Research Chemist, 220 Washington Street, Boston, Mass.

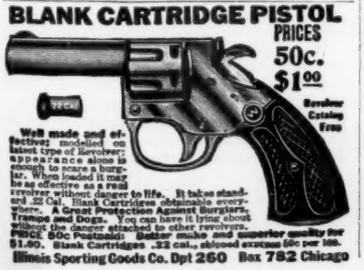
NEW BOOKS

CONCENTRATION. How to keep your mind on one subject, despite interruptions. Wonderful possibilities through psychology of thought control. Book 50c. Another book, "HOW TO CONQUER FEAR," shows how to avoid worry, doubt, nervousness; gain contentment; 50c. Both, $1. Satisfaction or money back. Centre Publishing Co., 108 West 34th St., N. C., New York.

GLOVER'S FAMOUS
KEY CASE
GUARANTEED
GENUINE LEATHER
FLAT — SMOOTH — NEAT
SAVES YOUR POCKETS
$1 POST PAID FROM MANUFACTURER
ORDER NOW — COLOR BLACK
R. M. GLOVER Mfg. Dept. M.
1443 Park Place, Detroit, Mich.

CUT YOUR GAS BILL ONE HALF
A Bright White Light of 55 c. p.
It's Guaranteed Four Months
Jap Fibre Inverted Mantle
Get Yours Today—25c Each
5 for $1.00 prepaid
AMERICAN GAS MANTLE CO.
38-B Pickering Bld. Cincinnati, O.

BLANK CARTRIDGE PISTOL
PRICES
50c.
$1.00
Revolver Catalog Free



Well made and effective; modeled on latest type of Revolver; appearance alone is enough to scare a burglar. When loaded it may be as effective as a real revolver without danger to life. It takes standard .22 Cal. Blank Cartridges obtainable everywhere. A Great Protection Against Burglars, Tramps and Dogs. You can have it lying about without the danger attached to other revolvers. PRICE, 50c Postpaid. Better model and superior quality for $1.00. Blank Cartridges .22 cal., shipped express 50c per 100.
Illinois Sporting Goods Co. Dpt 260 Box 782 Chicago

The Falsework for a Big Dam

(*Continued from page 204*)

face. Where the canyon is not especially V-shaped, the span does not change much from level to level. The pressure does increase toward the bottom; so that the arch must have greater and greater resistive capacity as one passes from upper to lower levels. In this Warm Springs Dam, the up and downstream faces are essentially parallel from the crest to a level 20 or 25 feet farther down. But from this point down, parallelism is lost. The dam steadily thickens by the battering of the downstream face. This thickening combined with some shortening of the span provides the necessary greater and greater resistive capacity. In two of the views, this thickening on the downstream, or concave, side may be noted by observing the bent trestle posts on that side.

The trestlework shown in the views is one and the same trestle in all. The concrete is, however, at various levels. Where the concrete has risen to a level approaching that of the crest, a good deal of the horizontal timbering has been removed and naturally a lot of oblique bracing is also gone. The long and vertical posts are still in evidence. By using a single trestle structure for the upper half of the dam, the provisions for horizontal transportation along the curved length of the dam were simplified. One floor and one set of tracks were all that were required instead of a reconstruction of floor and tracks at various levels as the dam grew. The concrete was delivered through bottom-dump buckets and these discharged into a flexible metal pipe 8 inches in diameter. The mixing plant was set at a high level and discharged into the buckets.

Of course, the trestlework was not the form for the faces of the dam. Still it supplied supports for the temporary attachment of the form sheets. The constant curvature naturally simplified the design of these forms, especially on the upstream face. A representative form was 4 feet high and 14 feet long. It was set in between trestle posts and secured by dowels penetrating the posts.

The posts were secured to the rising concrete by an anchor for each lift of 4 feet. That is, an anchor would be imbedded in the concrete, and then a bolt through the post would be secured to it. The anchors were arranged to be flush with the concrete surface.

The dam is 549 feet long, 469 feet of this being curved. This is a crest measurement. At the base, the length is 200 feet. The spillway length of the crest is 324 feet. When the water is 5 feet deep on the spillway, 12,000 sec.-ft are passed over. This is probably ample for floods, as the maximum run-off on record is less than one-half of this.

The length of the dam is divided into five sections by expansion joints. These joints are not simple axial planes. There is in each on one face a rectangular depression 6½ x 30 inches in cross section, and in the other face a similar projection, the two coacting. There is thus a tie between the one face and the next and a provision to cut off seepage. The joints are drained by long 4-inch pipes which discharge at the dam's base.

The provisions for unwatering to a fairly low level the basin lying back of the dam are of interest. The central radius of the dam extends to the north. On the west side are the sluice vents. The water to reach them must swing southward paralleling the upstream face and pass into two inlets where stoplanks are arranged. These openings are in a vertical plane at right angles to the face of the dam. Entering, it swings around a right-angled curve, two conduits guiding, and then enters the sluiceways proper and passes through the base of the dam at right angles to its faces

(*Continued on page 219*)

W. L. DOUGLAS

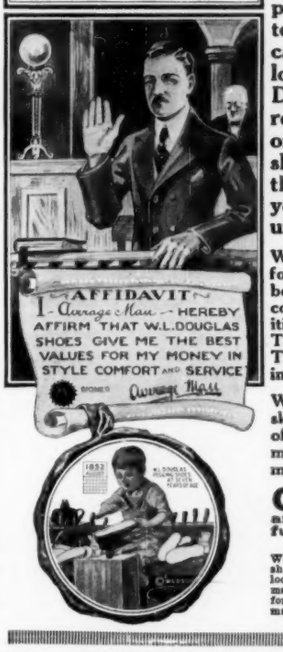
Retail Price Reduced **$8.00 SHOES** Quality of Material and Workmanship Maintained

Special Shoes Hand Workmanship $10.00 ‖ Special Shoes Stylish and Durable $6.00

FOR MEN AND WOMEN

THE STAMPED PRICE IS W. L. DOUGLAS PERSONAL GUARANTEE THAT THE SHOES ARE ALWAYS WORTH THE PRICE PAID FOR THEM

YOU CAN ALWAYS SAVE MONEY BY WEARING W. L. DOUGLAS SHOES SOLD DIRECT FROM FACTORY TO YOU AT ONE PROFIT


AFFIDAVIT
I - Average Man - HEREBY AFFIRM THAT W.L.DOUGLAS SHOES GIVE ME THE BEST VALUES FOR MY MONEY IN STYLE COMFORT AND SERVICE
Average Man

They are the best known shoes in the world. Sold in 107 W. L. Douglas stores, direct from the factory to you at only one profit, which guarantees to you the best shoes that can be produced, at the lowest possible cost. W.L. Douglas name and the retail price are stamped on the bottom of all shoes before they leave the factory, which is your protection against unreasonable profits.

BOYS SHOES $4.50 & $5.00

W.L.Douglas shoes are absolutely the best shoe values for the money in this country. They are made of the best and finest leathers that money can buy. They combine quality, style, workmanship and wearing qualities equal to other makes selling at higher prices. They are the leaders in the fashion centers of America. The prices are the same everywhere; they cost no more in San Francisco than they do in New York.

W. L. Douglas shoes are made by the highest paid, skilled shoemakers, under the direction and supervision of experienced men, all working with an honest determination to make the best shoes for the price that money can buy.

CAUTION Insist upon having W. L. Douglas shoes. The name and price is plainly stamped on the sole. Be careful to see that it has not been changed or mutilated

W. L. Douglas shoes are for sale by over 9000 shoe dealers besides our own stores. If your local dealer cannot supply you, take no other make. Order direct from the factory. Send for booklet telling how to order shoes by mail, postage free.

W. L. Douglas
President
W. L. Douglas Shoe Co.,
163 Spark St., Brockton, Mass.

EARLY IN APRIL we shall publish in book form the winning essay in the

$5,000 Einstein Prize Essay Contest

together with several others of the best essays submitted, carefully selected extracts from a comparatively large number, and such editorial comment and supplementary material by the Einstein Editor as may be necessary to cover the subject in its entirety.

Three hundred contestants competed for this prize; wherever one of them has succeeded in saying one particular thing better than any of the others have said it, this part of his essay will be found in the book. The book will therefore be, in effect, by 300 authors, many of them eminent scientists, and will comprise the best that each one has to give. It will be the most understandable of the books on relativity that are reasonably complete, the most complete of those that are reasonably understandable; for the average reader it will be altogether the best book on the great revolution which Einstein has effected in the foundations of science.

Every book of any account on relativity that has yet been put out has been exhausted within a few days of publication. There is one way to make sure that we will have a copy of this book for you—order it now. The title is

Relativity and Gravitation

The price is $2; or by mail, $2.15

ORDER IT NOW

Scientific American Publishing Co.
Woolworth Building, New York

RECENTLY PATENTED INVENTIONS

(Continued from page 216)

knowing the combination may unlock the lock.

AUXILIARY LEVER ATTACHMENT FOR JACKS.—S. P. BARKER, 430 W. 48th St., Montclair, N. J. The invention relates to hoisting apparatus and has particular reference to lifting jacks designed especially for being applied beneath the rear axle of an automobile or other place that is ordinarily more or less inaccessible for the positioning and manipulation of a lifting jack by means of the usual short lever, the special lever provided being jointed and foldable into small lengths.

BORING TOOL.—L. P. CROSMAN, Deering Junction, Portland, Me. The invention has for its object to provide a boring tool comprising a rotary head and flat spiral bits secured thereto and extending from the end thereof outwardly and rearwardly along the surface of the head, the head being cut away beneath and to the rear of the bits to provide clearance for the chips.

TOOL HOLDER.—W. S. WHYTE, Bedford, Ind. The invention relates to devices associated with pneumatic-operated tools for holding the latter so that the tool may be operated without transmitting its motion to the handle and hands of the operator, whereby injury and other attendant disadvantages are eliminated. It is a purpose of the invention to provide a holder which is extremely simple, but which effectively absorbs all shocks and jars.

MARKING APPARATUS.—W. C. MORGANS, Dubuque, Iowa. An object of the invention is to provide means for burning identification characters in furs or skins of any character, which cannot be obliterated by the ordinary tanning process. The apparatus comprises a stencil adapted to be located against the skin, and an electric hot point adapted to pass through the perforations.

CLAMP.—C. DRAKE, Mannington, W. Va. An object of the invention is to provide a clamp which can be conveniently secured around a post. A further object is to provide a clamp which is especially adapted for use in metal frame structures, and is adapted to clamp posts or standards of tubular or cylindrical form and provide a secure and convenient means for connecting the braces and girders to the post.

LOCK FOR MAIL BOXES.—R. B. LILLARD, 2822 Boulevard, Jersey City, N. J. This invention has for its object to provide a lock especially adapted for use with a series of mail boxes, for instance, the boxes of apartment houses, for permitting the simultaneous release of the doors of all the boxes, or to lock the boxes, without interfering with the locks pertaining to the individual mail boxes.

COMBINATION TOOL.—S. P. HOLISH, 2101 Marshall Blvd., Chicago, Ill. Among the objects of the invention is to provide a tool which combines a plurality of tools ordinarily provided as separate implements, performing the different operations ordinarily performed by the tools with equal effectiveness and a great saving of time. The device consists of a saw blade, whereby a combination tool is formed comprising a handsaw, a square, a ruler or scale, and a bevel.

Heating and Lighting

STOVE AND FIREPLACE.—O. V. BUMPASS, Corinth, Miss. This invention has for its object the provision of a device of the character stated especially adapted to be arranged in a fireplace opening and possessing when so arranged the capability and utilities of both a stove and a fireplace. A further object is to provide a device which is simple and of durable construction, and inexpensive to manufacture.

COMBINED GRATE AND ASH SIFTER.—J. A. LONG, 506 Norwood St., East Orange, N. J. Among the objects of the invention is to provide a construction including a sifter for ashes located in the ash pit beneath the grate, and means to cause the sifter of the ashes simultaneously with the shaking of the grate, and the delivery of the clinkers or unburned lumps of fuel forward of the ash pit whence they may be scooped up to be reburned or otherwise disposed of.

FURNACE.—L. J. CLOSSEY, 587 Fairview Ave., Detroit, Mich. This invention more particularly relates to hot air furnaces, an object being to provide a furnace composed of sections secured together and forming an arrangement of air passages and smoke passages whereby the maximum of highly heated radiating surface is utilized. A further object is to provide a free draft without danger of soot or ash accumulating to interfere with the draft or radiation of the heat.

Machines and Mechanical Devices

SPINDLE OILER.—M. F. WILLIAMS, Gilbertville, Mass. An object of the invention is to provide means for oiling a series of spindles, which results in rapidly and uniformly applying the lubricant to the spindles without wastage and without soiling the parts of the machine or the floor, a brush applying the proper quantity of lubricant to each spindle as the device moves along.

FOOD DELIVERING AND ORDERING APPARATUS.—W. F. MCGLAUGHLIN, 470 So. Grant St., Denver, Colo. The invention relates to apparatus for automatically delivering trays of food to diners in restaurants, the apparatus being utilized to return the empty dishes to the kitchen of the restaurant. A further purpose is to provide an apparatus for ordering the dishes and for delivering the order to the kitchen, thus eliminating the intermediaries necessary for the transmission of orders from the diners to the chef.

SAND STRAINER.—O. R. KIRSCHKE, 1116 W. 3rd St., Grand Island, Neb. This invention has for its object to provide mechanism for use in connection with well casings for thoroughly removing sand from the water before it enters the body of the well casing, the strainer having a sand chamber between the bore and the exterior for receiving the sand, together with means for causing the sand to settle.

PISTON.—A. NERAAS, P. O. Box 345, Massillon, Ohio. The invention relates particularly to that class of piston in which the packing bushing is removable from the inner or working side of the piston head. The piston comprises a body having a reduced portion on its working side, a cup shaped bushing completely covering the same, a packing ring on the bushing, a ring removably secured to the bushing for retaining the packing ring and a key for locking said ring in position.

HYDRAULIC CONCENTRATING APPARATUS.—W. E. SUDLOW, Lincolnton, N. C. An object of the invention is to provide means for forcing the ore in a stream of water upwardly in an inclined pipe and to provide an arrangement of boxes in communication with the pipe for receiving the ore. A further object is to provide an apparatus which is particularly adapted for use in the recovery of tin ore, but is also adapted to any ore with greater specific gravity than the gangue.

SHUTTLE THROWING MECHANISM.—N. PEPIN, 172 Lincoln St., Woonsocket, R. I. This invention relates to looms and its object is to provide a shuttle throwing mechanism arranged to impart a powerful movement to the shuttle to move the same through the open shed without danger of striking therein. Another object is to permit of readily applying the shuttle to power looms as now constructed.

RECORDING DEVICE.—W. D. PEARSON, 734 East Main St., Portland, Ore. The principal object of the invention is to produce a recording device which may be used in recording the hours or periods of operation of a machine, such for instance as a flying machine, with which the device is associated. A further object is to produce a device which will be automatic and will start recording as soon as the device to which it is attached commences to operate and will cease when the device ceases operation.

Medical Devices

DENTAL ENGINE HANDPIECE.—R. C. CRAIG, Abingdon, Va. A purpose of the invention is the provision of a handpiece of simple, durable and efficient construction, including a clamp for effectively securing the tool so as to prevent its accidental displacement and to securely lock the same to the engine shaft for positive rotation. A further object is to provide a handpiece having means for adjusting the tool clamp while the tool is rotated.

Musical Devices

SECURING MEANS FOR THE ENDS OF STRINGS FOR INSTRUMENTS.—O. J. MULLER, 509 E. 76th St., New York, N. Y. The invention relates to an anchor for the end of a string adapted to be used in connection with musical instruments, and particularly the "E" string for a violin. The device provides a simple form of anchoring means adapted to be applied to the key with the loss of only an instant of time. The device is equally applicable to any of the strings of a violin, or the strings of any musical instrument or a harp.

SOUND RECORDING AND SOUND REPRODUCING MACHINE.—J. H. NEHER, 61-79 Hall St., Princeton, N. J. The principal object of this invention is to provide means for the recording and reproducing of lengthy speech or music on a plurality of records, whereby the continuous recording or reproduction can be readily obtained without noticing the transition from one record to another. The operator being given ample time to place the new record in position, prior to the stylus, in engagement with the active record, reaching the end of the sound groove.

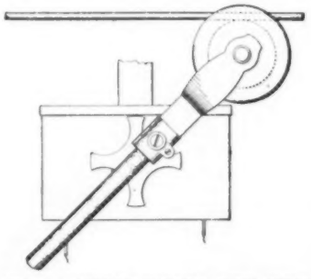
Prime Movers and Their Accessories

SPARK PLUG.—E. P. NICHOLSON, 371 Quincy St., Brooklyn, N. Y. A purpose of the invention is to provide a double electrode spark plug which will simultaneously produce twin sparks to facilitate combustion in the gas engine cylinder. It is also a purpose to provide a double sparking plug so as to make it unnecessary to employ two separate spark plugs in airplane engines, high speed automobile racing motors, and large stationary working engines.

Railways and Their Accessories

COMBINED SIGNAL AND EMERGENCY TRAIN STOPPING DEVICE.—J. W. HUBBARD, 447 Grand Ave. West, Eau Claire, Wis. This invention has reference more particularly to a signal which may be set up on a railroad track a short distance behind, or in the case of a single track system, also in front of the train which is standing still, to warn the engineer of a train approaching against proceeding farther, also in lieu of the signal being disregarded, to provide means as an emergency to prevent a collision by derailing the approaching train.

RAILROAD SIGNAL.—W. H. HARRELL, 210 N. Peak St., Dallas, Texas. The invention relates particularly to automatic signals for displaying a warning at grade crossings. An object is to produce a signal for use on electric and steam railway lines to warn pedestrians and vehicles of the approach of the car or train. The signaling system operates a semaphone, rings a bell, or illuminates a light, an electric circuit being actuated during the passing car or train.

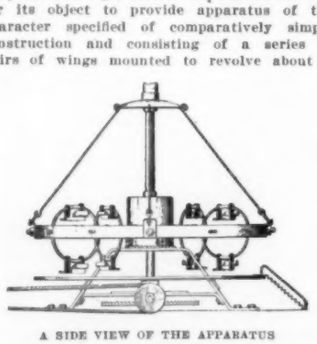


SHOWING A SWITCH HOUSING WITH ELECTRIC TROLLEY PASSING

RAILWAY SIGNAL FLAG.—W. A. JOHNSON, 202 Quincy St., Fairmont, W. Va. The object of this invention is to provide an arrangement by which flags of different colors may be carried; each of which is normally rolled upon a conventional curtain roller and may be readily inserted in cylindrical flat containers so that each flag may be drawn out through a slot in the container wall, independent of the other, and the tension adjusted as desired.

Pertaining to Recreation

AMUSEMENT APPARATUS.—P. D. HAUNSON, Breckenridge, Mont. This invention has for its object to provide apparatus of the character specified of comparatively simple construction and consisting of a series of pairs of wings mounted to revolve about a common vertical axis, and to rotate each upon a horizontal axis, with the members of the pairs so arranged that the spheres described by the rotation of the rings will intersect.



A SIDE VIEW OF THE APPARATUS

Pertaining to Vehicles

RESILIENT DRIVE MEANS.—C. BEARENS, 106 Bank St., New York, N. Y. The general object of the invention is to provide means to connect a drive element with a driven element as for example a drive shaft with a driven shaft, the invention being more particularly intended to have special advantage when interposed in the transmission means of a motor driven vehicle.

VEHICLE ALARM.—D. A. GILLEN, 115 N. 15th St., Flushing, L. I., N. Y. Among the objects of the invention is to provide an attachment for vehicle wheels which is in the nature of a large gong which, when carried by the rotating wheel, will be brought with such impact against the roadway as to cause a clanging noise sufficient to inform the public or officers that the vehicle so moved is being stolen.

VEHICLE WHEEL LOCK.—L. M. EGBERT, 414 Clinton St., c/o F. M. Risley, Elizabeth, N. J. The object of the invention is to provide a wheel lock more especially designed for use on the wheels of automobiles, auto trucks and other vehicles, and arranged to enable the person in charge to readily lock the wheel to the axle to prevent rotation of the wheel and safeguard the vehicle. A further object is to provide a lock which can be readily applied to wheels as now generally in use.

LOCKING DEVICE FOR TRANSMISSIONS.—A. E. STENBERG, Reed City, Mich. The invention relates to means for controlling transmission and comprises a rod and a sleeve mounted to slide with respect to each other, the sleeve being cut away at one side to the level of the rod and the rod and sleeve having transverse notches at the cut away side adapted to register, and a bolt mounted to slide toward and from the rod and sleeve to lock the rod and sleeve, a spring normally pressing the bolt in engaging position.

HEATING FOR AUTOMOBILES.—G. S. KING, address John Tuomey, 157 E. 72nd St., Bay Shore, N. Y. The object of the invention is to provide a heater for automobiles and other power-driven vehicles located within the hood adjacent the internal-combustion engine to heat the latter with a view to prevent the water of the cooling system from freezing and keeping the heater ready for starting the motor whenever it is desired to do so.

IDENTIFICATION MEANS FOR AUTOMOBILES.—J. BILLINGS, Park Row Bldg., Room 623, New York, N. Y. To enable a stolen automobile to be quickly identified even among a large number of the same make, this invention utilizes one of a group of bolts or other parts of which several are alike, and distinguishes the selected part by a secret mark or a concealed card. Thus, the identifying part of the machine is massed by its resemblance to other similar parts, and this feature also requires that all removable parts be removed for the theft to be safely accomplished.

RIM.—C. M. MCKENDREE, Lakeview, Ore. An object of the invention is to provide a rim of circular form, having its ends slightly placed apart to allow for expansion and contraction of the rim, said rim adapted to be contracted by the inflation of the tire, the pressure of air in the tire causing a contraction of the rim. A further object is to provide a rim which can be conveniently connected to or disconnected from the wheel.

LOCK FOR MOTOR VEHICLES.—M. FARAH, 408 San Francisco St., El Paso, Texas. This invention has for its object to provide a device of the character specified, suitable for use with motor vehicles of any character, for simultaneously locking the gear shift lever from movement and for breaking the ignition circuit.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

MUNN & CO., Solicitors of Patents

Woolworth Building, NEW YORK
Tower Building, CHICAGO, ILL.
Scientific American Bldg., WASHINGTON, D. C.
Hobart Building, SAN FRANCISCO, CAL

The Falsework for a Big Dam

(*Continued from page 217*)

at this point. There are two sets of gates. One pair is in practically the same plane as the upstream face, the second pair is set underneath the upstream toe—that is, a little downstream from the first set. The control rods for the first set reach down the vertical convex face, while those for the second set are provided with wells, of horse-shoe horizontal section, which extend up to the crest. Both sets of sluice gates may be operated from the top of the dam. In case a vacuum forms because of the flow of the water, at any time, a vibrating action of the gates may take place. In order to prevent the formation of a vacuum in the sluiceway between the downstream gate and the downstream face of the dam, a duct is arranged which leads from the ceiling of the sluiceway up a short distance and then horizontally to the dam's downstream face.

Making Electric Insulators of Porcelain

(*Continued from page 205*)

Milady is very proud of the glossy appearance of the dinner set on her dining table. But the glaze that gives it a glossy sheen is not there merely for looks. The cups would not hold coffee or tea, and the plates would be soaked with grease were it not for the glazing that renders the more or less porous porcelain impervious to moisture.

And that is exactly the reason why porcelain insulators are glazed. While moisture might not penetrate them extensively, it would cling on the minute rough edges of an unglazed surface and tend to create a film of water which would impair their insulating properties.

The glazing consists of the same material as the porcelain with the addition of calcium carbonate or whiting, which cause the glaze to melt at a lower temperature than the porcelain. It is applied, in the form of a thick liquid, in several ways. Small articles are coated by means of an automatic sprayer which resembles a huge atomizer and sprays the glaze over them. Others are sprayed by hand, and still others are dipped into the glazing fluid.

After glazing the porcelain is placed in receptacles made of fire-clay resembling the casserole familiar to the housewife, and these are piled in great columns inside the kilns—huge structures of brick about fifteen feet in diameter and sixteen feet high, beneath which is a furnace. When the kiln is full, the door is walled up with brick and fire clay, and the fire started.

Three cones, called pyrometric cones, are made from the same materials as the porcelain. The proportions are so changed, however, that the tip of one of these cones will bend over at 20 degrees Centigrade less than the melting point of the porcelain, while the third requires 20 degrees more to melt it than the porcelain. These cones can be seen through a small apperture in the kiln. The melting of the first warns that the heat is approaching the desired degree. When the second one melts, the fire is carefully manipulated so that the heat will not rise to a degree that would melt the third.

The intense heat, upward of 1,360 degrees Centigrade, melts the glaze, which runs evenly over the outside surface of the porcelain, and vitrifies the latter, making it a hard, dense, impervious mass.

After the porcelain has been baked for the requisite length of time and the contents of the kiln have cooled sufficiently, the articles are removed and tested. Not only must the insulators meet specifications as to size—and that, as indicated, takes very careful work—but they must be tested for their insulating strength. The larger insulators are subjected to tests at from 60,000 to 300,000 volts.

The testing is one of the most interesting phases of the work. The spectator sees a row of insulators to which wires are attached. The operator throws on the current. Down one of the insulators goes a spitting blue line of "fire" with a crackling noise. The visitor's face tingles from the electricity in the atmosphere, and there is a pronounced odor of ozone from the oxygen liberated in the air.

A Measure of Interior Lighting

(*Continued from page 205*)

involved the making of test objects, such as neutral gray specimens by mixing black drawing ink and lamp black with a white cement. After being surfaced with coarse sandpaper, resulting in good diffusers, the surfaces were tested for light-reflecting factors by the observation of surface brightness at intervals of 10 degrees. A block of magnesium, a polished sheet of milk glass and white-painted cardboard were supplement to the test specimens above-mentioned. The high reflection factor obtained for magnesium carbonate was the outstanding result of the experiments.

Who Shall Work the Farms?—II

(*Continued from page 208*)

Maine, which normally produces 60 per cent of the potato crops in New England, experienced setbacks in unfavorable weather, strikes, labor shortages and transportation embargoes which impeded the normal activities.

California planted 60 per cent of normal acreage of all varieties of beans, limas being 90 per cent and other varieties 45 per cent of 1919. New York planted 90 per cent as many beans as last year; Michigan, 75; Wisconsin, 70; Colorado, 65; New Mexico, 80; and Idaho, 100. This sort of thing cannot continue without serious results.

Not only is farm labor scarcer than usual but it is more independent and less efficient, according to reports of farmers from all sections of the country. Those who are attracted to towns, cities and public works get more pay and work fewer hours than they did when on farms while those who remain on the farms are also demanding shorter hours. There is a wide complaint among farmers generally of the eight-hour-day movement which promises to be the elusive bugaboo of the future.

Typical reports from farmers are aptly illustrated by the following: A Wisconsin farmer says, "Decreased acreages, decreased yields and high prices for foodstuffs are sure to result due to the farm help movement cityward. I cannot get help. I am 60 years old and have only two boys to assist me in handling a 300-acre farm. Unless conditions right themselves I shall finally be forced to let my farm run to weeds."

A Minnesota farmer remarks, "I have hired help for 35 years and this is the first season when I was unable to secure any assistance in operating my farm. I am forced to seed the place down to grass." From Virginia, a farmer wrote that his community was practically with out labor. Farms that usually hire three men were using only one and these work only eight hours a day. His neighbor, a Tennesseean, says, "If the farm labor situation continues as now for two or three years longer, a man who does not own a farm will be denied even drinking water. If factories and mills do not cut down their wages, hard times are sure to come to all."

A New York farmer who handles 300 acres has only one man where he usually uses three. He says he cannot afford to pay a minimum wage of $4 to $5 a day when crops sell at present prices as the production costs more than absorb all the income. The sentiment of a number of Connecticut farmers is that they will not produce 50 per cent of what they raised last year. They cannot compete with the

At more than twenty-two thousand garages, in town and country, empty Prest-O-Lite Gas Tanks may be exchanged for full ones.

With daylight on the runningboard who cares for darkness?

THE bumps and jars of rough going can not in any way affect the rugged Prest-O-Lite Gas lighting system. Nor can the range and intensity of the light be impaired. There is nothing to work loose, wear out, nor break—nothing to deteriorate.

A few minutes work requiring no mechanical nor technical knowledge, and the Prest-O-Lite Gas lighting system may be installed on any truck—ready for instant use during the entire life of the sturdiest vehicle.

Because of the Prest-O-Lite Gas Exchange System, truck drivers may replace empty Prest-O-Lite Gas Tanks with full ones at more than twenty-two thousand garages and stores throughout the country. Fully charged tanks are put on in a few moments with no other tool than a wrench.

The Prest-O-Lite Gas Tank offers the maximum of lighting with the minimum of weight and bulk. Because of the solvent employed, the capacity of the Prest-O-Lite Gas Tank is increased ten fold. A tank measuring only 6 by 20 inches will keep two headlights burning for 40 hours!

There is a Prest-O-Lite Gas Distributor near you—write for his name and address.

Our complete line of appliances using only Prest-O-Lite Gas and air suitable for soldering, brazing, paint burning, etc., is extensively used by manufacturers and in repair shops everywhere.

THE PREST-O-LITE COMPANY, Inc.
Small Tank Sales Department
General Offices: Carbide and Carbon Bldg., 30 E. 42nd St., New York
599 Eighth Street, San Francisco
In Canada: Prest-O-Lite Company of Canada, Limited, Toronto

PT-502-21C

WIRE electrical, rope, airplane, piano, pipe-organ, flat, hoops, bale-ties, tacks, nails barbed wire, concrete reinforcement, springs, netting, wire fences, steel posts, trolley-road wires and rail bonds, wire wheels, auto-towing cables, horse-shoes.
Illustrated Books Describing Uses, FREE
American Steel & Wire Co. F. Baackes, V.P. & G.S.A. CHICAGO

POWER BENDERS TWO NEW MODELS
"Wonder" Cold Pipe Bending Machines (Pat.) electrically operated to bend from 1 in. to 8 ins. Send for printed matter. We also manufacture TEN other sizes, hand operated to bend from 1-8 inch to 6 inches.
American Pipe Bending Machine Co.
Manufacturers
32 Pearl St., Boston, Mass., U.S.A.

DELUXE LIGHT WEIGHT CAST IRON PISTON
"The Successful Light Weight Piston" ©
PATENTED U.S.A.
FOREIGN PATENTS PENDING
LOOK INSIDE YOU CAN'T GO WRONG
VERY LIGHT AND VERY STRONG

Do You Own a Car?
DELUXE light weight, cast iron pistons will increase the power, speed and flexibility of any motor and at the same time use less gasoline and oil. They also reduce repair bills by eliminating vibration. Thousands of motorists in every part of the world are proving this every day.

DELUXE PISTONS ARE 40 TO 50% LIGHTER THAN STOCK FACTORY CAST IRON PISTONS

The weight is saved and strength gained by their patented scientific reinforced construction. Note the reinforcing ribs under the head and down the skirt. These reinforcements give the piston much greater strength. The reinforcing ribs also serve to carry off heat, insuring a cooler running motor. The DELUXE piston has much less expansion than either aluminum or heavy cast iron pistons. They can be fitted close.
Write for booklet giving full information. Supplied standard or over-size for more than 800 makes of automobiles, trucks, tractors, airplanes, motorcycles and marine engines.
Patented and Manufactured by
CLARK-TURNER PISTON CO.
Station C Los Angeles, Calif.
For Sale by All Good Dealers and Repair Men.

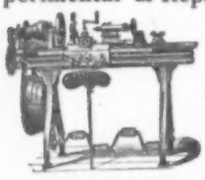
WELL DRILLING PAYS **WELL**
Own a machine of your own. Cash or easy terms. Many styles and sizes for all purposes
Write for Circular.
WILLIAMS BRÓS., 434 W. State St., Ithaca, N.Y.

Tycos
TEMPERATURE INSTRUMENTS
INDICATING · RECORDING · CONTROLLING

CHART TEMPERATURE FACTS—
CONTROL THE TEMPERATURE

Tycos instruments give that steady, day-after-day indication, record or control of temperature factors that stamp them as pre-eminent in every industry. Specify them when you want those exact, vital, temperature facts that throw light on temperature problems—help *solve* them.
Catalog and consultations on request. No obligation.
Taylor Instrument Companies
Rochester, N. Y.
There's a Tycos or Taylor Thermometer for every purpose.

For Gunsmiths, Tool Makers, Experimental & Repair Work, etc.



From 9-in. to 18-in. swing. Arranged for Steam or Foot Power, Velocipede or Stand-up Treadle.

W. F. & J. Barnes Co.
Established 1872.
1999 Ruby Street
Rockford, Ill.

We Will Make It
Anything in a metal stamping or novelty produced from any metal and finished in any color.
Waterbury Button Co., Waterbury, Conn.

1/4 MOTORS
H. P., 110 volts, A. C., 60 cycle, single phase, 1750 R. P. M.
LARGE QUANTITIES NEW WASHING MACHINE MOTORS
$22.75 Each

CHAS. H. JOHNSTON - Box 23 W. E. Pittsburgh, Pa.

BRIGGS' THERMOSTATIC METAL
J. BRIGGS & SONS CO
67 Clifford St. PROVIDENCE, R.I.

SOUTH BEND LATHES
For the Machine and Repair Shop

9" Lathe $215.00
11" Lathe $275.00
13" Lathe $365.00
15" Lathe $450.00
16" Lathe $525.00
South Bend Lathes are made in eight sizes, 9-in. to 24-in. swing, inclusive.
Established 1906
Free Catalog
How to Run a Lathe
An 80 page book
For 10c Postpaid
Coin or Stamps
South Bend Lathe Works
421 Madison Street
South Bend, Ind.

THE SCHWERDTLE STAMP CO.
STEEL STAMPS LETTERS & FIGURES
BRIDGEPORT CONN.

Just Off the Press

The Modern Motor Truck

DESIGN, CONSTRUCTION, COMMERCIAL APPLICATION, OPERATION, REPAIR

1000 Pages, 750 Illustrations
Price, $5.00; By Mail, $5.25
By Victor W. Page, M.S.A.E.

Covers Everything You Should Know About Gasoline and Electric Trucks

This is a new 1921 book considering all types of motor trucks and industrial tractors and trailers. It outlines features of all types of trucks, gasoline and electric, and all varieties of truck bodies. This book is written in language everyone can understand and is not in any sense of the word a technical treatise. It is a practical book that will make special appeal to the truck driver who seeks to better his position and to the mechanic charged with the repair and upkeep of trucks.

Simple in treatment — An encyclopedia in scope. Not a technical treatise but a book for the practical business man and mechanic.

Copies of this book sent prepaid on receipt of price.

Scientific American Publishing Co.
Woolworth Building, New York

industries for labor on the basis of present prices for farm products. Oregon farmers are doing what they can with family labor and are letting the rest of their work go undone. They refuse to pay industrial rates for farm work. Kansas farmers are trying to readjust their cropping calendars so as to do without high priced help. A New York farmer says that in his locality wages are 20 per cent higher than last year while the farm help is 50 per cent short. Complaint from the Southern States is that negro labor does only two-thirds the amount of work performed three years ago at one-third the present pay.

Ohio reports a ten per cent decrease in farm labor over last year and a correspondingly curtailed acreage. Indiana farmers say that demand for labor has declined because of high wages. Farmers have cut down their operations so that family labor can handle them. Alabama has only 70 per cent of normal labor supply while Mississippi has only three men available to do the work which requires four men. Arkansas reports a labor deficit of 15 per cent; North Dakota has only four-fifths as much labor as her farmers need. Oklahoma has a labor supply which is only 66 per cent of normal.

Practical and Inexpensive Farm Buildings from Willow Saplings

(*Continued from page 209*)

the Far East, or whether spurred on by the mother of invention, necessity, is still a mystery to some. At any rate, and in the short time of two days, according to the son who helped him, the barn was finished. The willows cut along the banks of a nearby stream were stripped of their twigs and leaves, and carted to the site of the building. Here the outline of the barn was marked on the ground, and posts set into the ground on this line, spaced four feet apart. The saplings were then woven about these uprights with the result shown in the accompanying photo of the barn. This single wall would offer protection to a certain extent from the weather but it would not be sufficient to withstand the winter blasts which would soon be upon them. So a second wall was erected about the first, in the same way, and the space between them kept to six or eight inches. Later this was packed with straw. The roof, of straw laid on saplings, which in turn were supported by poles running the length of the barn, on the top of the walls, furnished ample covering, though wire was woven in and out through the straw and the poles to keep it in place.

And so with the rest of the buildings. The poultry house has a plank roof, laid over the straw-covered rafters to keep the loose material in place. The corn crib has but the single wall, which is sufficient.

Another surprising feature about this unique farmstead was the many rods of fencing built of the same material, willow saplings. Almost a mile, all told, totals the combined length of the several fences.

The Four-Wheel Brake Again

(*Continued from page 209*)

The proper equalization of two brakes is a thing that is rarely accomplished satisfactorily and of course the equalization of four brakes presents still greater difficulty. Here again the hydraulic method has advantages. It should be evident that perfect equalization is secured, that is, the same force is applied to all four brakes since the pressure of the oil throughout the system is everywhere the same. Therefore the forces acting on the four brake pistons are equal and the brakes are applied with the same intensity.

Aside from these advantages the hydraulic system appears to be simpler and less likely to get out of order. The moving parts are limited to pistons and cylinders. The oil leads connecting the master cylinder with the brake cylinders are rugged, flexible metal tubes, and it should be recalled that great strides have been made in the construction of metal hose in the past three or four years; in fact it would not be surprising if this were the real reason for the advent of this system at this particular time. It is said that leakage is quite impossible.

Inasmuch as brake rods, arms, pins and bushings are entirely absent, metal tubing taking their place, one annoying source of rattle is eliminated. Brake linkage rattles are impossible where there is no brake linkage.

A Ditch-Digging Giant

(*Continued from page 209*)

Between the buckets, with semicircular cutting edges, side cutters are bolted to the wheel for hewing the ditch slightly wider than the buckets, thereby reducing the friction. The front end of the frame conveying the excavating wheel is hooked up to the rear of the platform carrying the power equipment. The rear of the frame is supported on a shoe that glides along on the bottom of the ditch, forming a smooth, shallow groove for the drainage tile. The maximum depth of digging is two-thirds the diameter of the wheel. Solid buckets are used for sandy soils, while skeleton containers, easily cleaned, are applied in sticky ground.

The machine is equipped, when desirable, with a cased shoe or shield to hold in abeyance the banks when operating in soil subject to caving. The cutting speed of this type of tile-trenching machinery ranges from 1 to 8 feet a minute. The varying sizes of this apparatus have capacities for digging trenches ranging from 11½ inches wide by 4½ feet deep to 18 inches wide by 6½ feet deep. Its capacity for overcoming obstacles is suggested by its past performances of slicing off tree roots as large as a man's arm. Then, too, unless they are buried deeply in the soil stones larger than the buckets are rolled away.

Solving the Labor Problem—IV

(*Continued from page 210*)

cuit of some of the best "movie" attractions. Here also lectures are delivered by well-known specialists in various fields of knowledge and travel. Another appreciated institution is the Marysville Club, which bears the significant name of "The Half Shell," as being synonymous with transparent square dealing, the inference being that an unworthy oyster is quickly determined on the half shell. This organization meets once a week, and its platform is occupied by well-known speakers of the country, men who are big successes in every line of business and professional activity. The matter of providing outdoor recreation, recognized everywhere today as one of the most important elements in promoting good fellowship in an industrial organization, is greatly favored by the fact that Marysville fronts upon the St. Claire River. Already bathing beaches have been formed and there is accommodation at the piers for yachts and small boats so that the employee can take his choice between recreation on land or water.

Thus far in its existence, Marysville has fully justified the expectation of its founders, and as its present population of 2,000 grows with the growth of the parent plant and the several associated industries which have located here, the success of this venture as a solution of the labor problem will be followed widely and with the keenest interest.

Bridges and Civilization

(*Continued from page 211*)

crossing them. Such original bridges were discovered without difficulty. Man had only to follow the example of the animals in flight which chose such means of escape. In the case of the swinging vine, however, the problem is twofold, since the savage was called on to decide whether to cross it by means of his feet or by means of his hands. Having decided to cross on his feet, a second vine sooner or later came into play as a natural railing or balustrade by which to support himself. Then followed the development of the wooden bridge, which type has persisted even to the present day.

It appears that the first iron bridges were erected at Colebrookdale from 1773 to 1779. The first German iron bridge was not built until 1794. Technologically speaking, the wooden bridge falls into three classes: Bridges of solid beams and girders, trestle bridges, and suspension bridges. The MONTHLY proceeds to show how these various classes were developed in many different parts of the world.

An interesting case is the bamboo bridge at Rantepoo, on the island of Celebes. It is believed that in this bridge we actually have the forerunner of our modern steel and iron cantilever bridges. As for suspension bridges of a primitive type, we find many such structures in the interior of western Africa and in New Guinea and elsewhere. An excellent example of bridge building is the arched beam bridge at Osaka, Japan. Architecturally speaking, it belongs to the girder bridge class, even though constructed of wood, with the members held together by an extremely ingenious system of ties and wedges in which presumably nails and screws are as absent as in the original Malay bridges verifying the fact that the Japanese have an infiltration of Malay blood.

Stray Current Electrolysis

DUE to the fact that return current was not formerly given the requisite attention to prevent it from straying from its fixed and narrow path, electric railway companies experienced considerable trouble with vagrant electricity of this description which had a predilection for wandering through the earth until it came in contact with underground pipes carrying the munipical water and sewage supplies or the telephone or telegraph wires. The stray current would run along these pipes for some distance and finally would jump back to the street car rails—which in the single, overhead trolley system carried the current back to the power house. An electro-chemical condition would develop at each point where the electric current would leave the pipes which gradually would cause minute disintegration and potentially the destruction of the pipes.

Some thirty years ago this phenomena first attracted public attention and it was some time before it was definitely ascertained that defective rail systems which did not properly confine and restrict the movements of the electric current which passed over them were fundamentally responsible for the difficulties. Heretofore, the bonded rail joint has been the weakest link in the return circuit and until the popularization and general adoption of the welded joint, the use of heavier rails, better bonds, and supplementary feeders, enormous damage to municipal pipe systems resulted in all parts of the country. Even today with conditions much improved and street car companies exerting every effort to control stray currents, the annual damages still are enormous.

The Federal Bureau of Standards has been aiding different cities all over the country in locating refractory pipe lines which have unknowingly become carriers of stray electric current. The work is of inestimable value to the cities in question as with the expert assistance of Uncle Sam's engineers the vagaries of the current are controlled. The demands for assistance of this character are usually far in excess of the force of experts available for such activities.

Industry finds a more pliable servant and electric motors a wider field of application through automatic control

G-E Industrial Controllers guide and conserve power in every industry

CONFIDENT, precise, powerful—a giant rears his head above the incompetence of Man and gives to Industry an automatic control of electric motors which knows no error nor fatigue.

G-E Industrial Controllers make the application of motors almost limitless in scope. They make motors practical on the most ponderous or the most delicate devices; they allow machines to operate at changeable speeds, thus eliminating complicated gears and reducing the chance for break-downs. They give a greater flexibility to a myriad types of appliances.

When thousands of dollars depend upon starting, stopping or reversing at exactly the right moment, G-E Industrial Controllers remove the human element and make it an unfailing, mechanical operation.

From the huge mass of technical data compiled through the past few years, G-E Engineers have an intimate knowledge of the requirements of most branches of industry. G-E Industrial Controllers are the outgrowth of this knowledge and in consequence are available in some special form for every kind of industry.

G-E Industrial Controllers simplify equipment, conserve power and floor space—save money. And when they are included at the time original plans are made, their saving is greatest of all.

All leading manufacturers of equipment will cooperate in furnishing G-E Industrial Controllers. Complete information may be secured from the nearest G-E office.

Look for this mark of leadership in electrical development and manufacture.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

43A-50

Chart of Recommendations
for AUTOMOBILES
(Abbreviated Edition)

GARGOYLE

Mobiloils

A grade for each type of motor

How to Read the Chart

THE Correct Grades of Gargoyle Mobiloils for engine lubrication are specified in the Chart below.

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

These recommendations cover all models of both passenger and commercial vehicles unless otherwise specified.

Where different grades of Gargoyle Mobiloils are recommended for summer and winter use, the winter recommendation should be followed during the entire period when freezing temperatures may be experienced.

This Chart is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and constitutes a scientific guide to Correct Automobile Lubrication.

If your car is not listed in this partial chart, consult the Chart of Recommendations at your dealer's, or send for booklet, "Correct Lubrication," which lists the Correct Grades for *all* cars.

NAMES OF AUTOMOBILES AND MOTOR TRUCKS	1920		1919		1918		1917		1916	
	Summer	Winter	Summer	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Alma	A	Arc	A	Arc	A	Arc	A	Arc		
Apperson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Bobbs	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac	A	A	A	A	A	A	A	A	A	A
Chalmers (6-40)									Arc	Arc
" (6-45)									A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet (4 cylinder)			A	A	A	A	A			
" (2 ½)			A	Arc	A	Arc				
" (1 ½ ton)	A	Arc								
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cleveland	A	Arc								
Cunningham	A	A	A	A	A	A	A	A	A	A
Dixie Flyer	A	Arc	A	Arc	A	Arc	A	Arc		
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Essex	A	Arc	A	Arc						
Federal (Model S-X)					A	A	A	A		
" (Special)					Arc	Arc				
" All Other Models	Arc	Arc	Arc	Arc	A	A	Arc	Arc	Arc	Arc
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
G. M. C. Trucks	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Grant (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Conv.) (Model 12)			A	Arc						
" " All Other Models	Arc	Arc	Arc	Arc						
Haynes (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cylinder)	A	A	A	A	A	A	A	A	A	A
Holmes	B	B								
Hudson Super Six	A	Arc	A	Arc	A	Arc	A	Ag	A	A
" All Other Models									Arc	Arc
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jones	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Jordan	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
King (8 cylinder)	A	A	A	A	A	A	A	A	A	A
Knox Kar (Model 68)									A	A
" (12 cylinder)					A	A	A	A		
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Liberty	A	A	Arc	Arc	Arc	Arc	Arc	Arc		
Locomobile	E	E	A	A	E	E	E	E	E	E
Lozier			Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Marmon (16 valve)	A	A	A	A	A	A	A	A		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Marmon	A	A	A	A	A	A	A	A	A	A
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Nelson	A	A	A	A	A	A	A	A	A	A
Mitchell (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	A
" (8 cylinder)									A	A
Moline-Knight			B	B	B	A	A	A	B	B
Monroe (Model M 2)										
" M C					A	Arc	A	Arc		
" All Other Models	A	A	A	A	A	A	A	A		
Nash (Quad)	A	A	A	A	A	A				
" (Model 671)					A	A				
" All Other Models	A	Arc	A	Arc	Arc	Arc				
National (6 cylinder)	A	A	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (12 cylinder)			A	A	A	A	A	A	A	A
Nelson	A	A	A	A	A	A	A	A		
Noble	A	A	Arc	Arc	Arc	Arc	Arc	Arc		
Oakland (8 cylinder)									A	A
" All Other Models	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Old Hickory	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Oldsmobile (6 cylinder)	A	A	A	A					Arc	Arc
" (8 cylinder)	A	A	A	A	A	A	Arc	Arc		
" (8 cylinder)	A	A	A	A	A	A	A	A	A	A
Oldsmobile	A	Arc	A	Arc						
Overland	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard	A	A	A	A	A	A	A	A	A	A
Paige (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" (Conv. Eng.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	A	A								
Pan (Model 3)	A	Arc	A	Arc	A	Arc				
" (Model 1916)									Arc	Arc
Peerless (8 cylinder)	A	A	A	A	A	A	A	A	A	A
" All Other Models					Arc	Arc	Arc	Arc	Arc	Arc
Pierce Arrow	A	A	A	A	A	A	A	A	A	A
" (Conv.) (5-ton)	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" " All Others	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	A	A	A
R & V Knight	A	A								
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Kiker	A	E	A	E	A	E	E	E		
Rock Falls	A	Arc	A	Arc						
Saxon	Arc	Arc	Arc	Arc	A	A	A	A	A	Arc
"			E	E	E	E	E	E	E	E
Scripps-Booth (4 cylinder)					Arc	Arc	A	Arc	A	Arc
" (6 & 8 cylinder)	A	A	A	A	A	A	A	A	A	A
Stearns-Knight	B	A	B	A	B	A	A	A	A	A
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Templar	A	A	A	A	A	A				
United (Grand Rapids) (2½ton)	A	A	A	A	A	A			Arc	Arc
" " (3½ ton)	A	A	A	A	A	A	Arc	Arc	Arc	Arc
" " (4 ton)	A	A	A	A						
" " (5 ton)	A	A	A	A	A	A	A	A	A	A
" " (7 ton)			A	A						
" All Other Models	A	A	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Velie (Model 7M)	A	Arc								
" (6 cylinder)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Conv.) (3½ ton)			A	Arc	A	Arc				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc				
Vim (Models 22, 23 and 24)	A	A	A	A						
" (Model 25) (1½ ton)	A	Arc	Arc	Arc						
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Wheel (16 valve)			A	A	A	A	A	A		
" (3 ton)			A	A	Arc	Arc				
" All Other Models			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Willys-Knight	B	A	B	A	B	A	A	A	B	A
Willys Six	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Wisther Six	A	Arc								
" (Conv.)	A	A	A	A	A	A	A	A		
Wisther-Morrison (1½ ton)	A	Arc	A	Arc						
" All Other Models	A	A	A	A						
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

Hard-used Cars

Where the Economy of using Gargoyle Mobiloils stands out sharply

THE harder a car works the quicker the driver notices the economy of scientific lubrication. Drivers of taxicabs and commercial cars soon find that scientific lubrication is more than a mere economy—it is a business necessity.

They experience the following conditions which the passenger car driver may note to his own advantage:

1 In traffic, low gear must be freely used. Unless the crank-case is filled with the correct lubricating oil, overheating is invited.

2 During waits, the engine frequently idles. On starting, the exhaust may smoke. The use of an incorrect oil exaggerates this smoke nuisance which in some places violates the law. The correct grade of Gargoyle Mobiloils maintained at the proper level, gives maximum freedom from exhaust smoke.

3 Taxicabs are run for profit. The correct grade of Gargoyle Mobiloils protects the user against undue repair bills and depreciation of investment.

4 Through the protection given at every friction point, and through the maintenance of a proper piston seal, Gargoyle Mobiloils nearly always show a reduced gasoline consumption.

5 Only with scientific lubrication can the engine operate flexibly. By using the correct grade of Gargoyle Mobiloils drivers find that they minimize the need for gear shifting. Driving in lower gears adds unnecessarily to gas consumption.

GARGOYLE

Mobiloils

A grade for each type of motor

YOU may drive your car only a few days per week, or a few hours per day. But, quite as much as the commercial car owner, you surely want operating economy.

The economies which Gargoyle Mobiloils show on hard-used cars are yours when you make the Chart your guide. This Chart is reprinted in part on the left. You will find the complete Chart on the walls of leading garages, auto supply stores and hardware stores. It is important for you to be sure that you use the grade specified for your car in the Chart. In using an oil which is either lighter or heavier you only invite trouble and waste. Not only the body, but also its character determines its fitness for your car.

We shall be glad to mail you a copy of our booklet on Automobile Lubrication. It contains the complete Chart of Automobile Recommendations. In writing please address our nearest Branch.

VACUUM OIL COMPANY *Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world* **NEW YORK, U.S.A.**

DOMESTIC BRANCHES: New York Pittsburgh Minneapolis Des Moines Boston Detroit Indianapolis Philadelphia Chicago Kansas City, Kan.